A McGRAW-HILL ELECTRONICS PUBLICATION
OCTOBER 1, 1984
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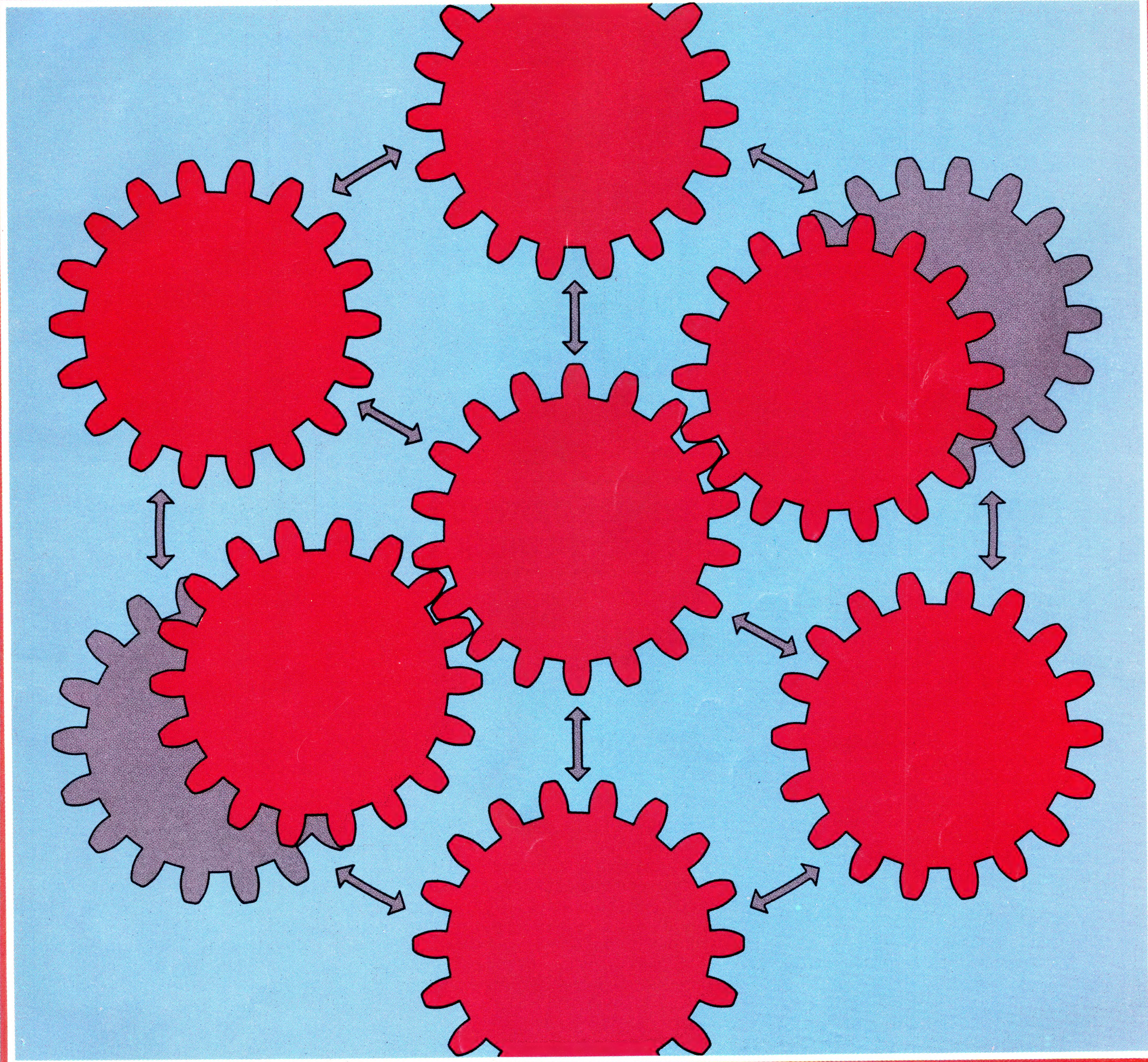
ElectronicsWeek®

HP beefs up Touchscreen computer

COMPATIBLE WITH PC/61

16 OCT RECD

MESHING MANUFACTURING TECHNOLOGIES/45



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BOB, CAROL, TED & ALICE

How Four Innovative Design Engineers Found Happiness Using The New DASH-1™ Schematic Design System.

BOB: "DASH-1 keeps me under budget and ahead of schedule..."

"DASH-1 has freed my designers from the drudgery of manual schematic design and documentation. Now, we can knock out complex designs in a fraction of the time it used to take. Using the huge DASH-1 parts library (on disk) we can instantly call up any symbols we need — all with pinouts and pin functions. With DASH-1's amazing options, we can generate Net Lists, Lists of Materials, Design Check Reports and other critical documents. I'm a hero in my company now, with productivity at an all-time high."

CAROL: "DASH-1 helped save our CAD Systems..."

"My company has a big investment in large CAD systems. But for a long time I noticed our engineers were frustrated. They'd send in schematic sketches only to get back drawings and documents that were completely different. The poor engineers would spend hours checking, changing and red-lining. DASH-1's family of CAD translators, to front-end all of our large systems, has changed all this. And back annotation is easy. DASH-1 has provided our engineers easy access to those previously difficult-to-use and inaccessible CAD tools."

TED: "Imagine! Simulation right at my desk..."

"I'm even more sold on my DASH-1 with its new simulator. After I complete my schematic, I have a closely coupled logic and fault simulator that I can run at my desk. I can analyze my designs much faster — and put them into production without delay. FutureNet calls it the DASH-1 CADAT.™ I call it a miracle because I can handle designs as large as 10,000 gates right at my desk, and up to 100,000 gates using a FutureNet CAD translator. Thanks to DASH-1, simulating is stimulating!"

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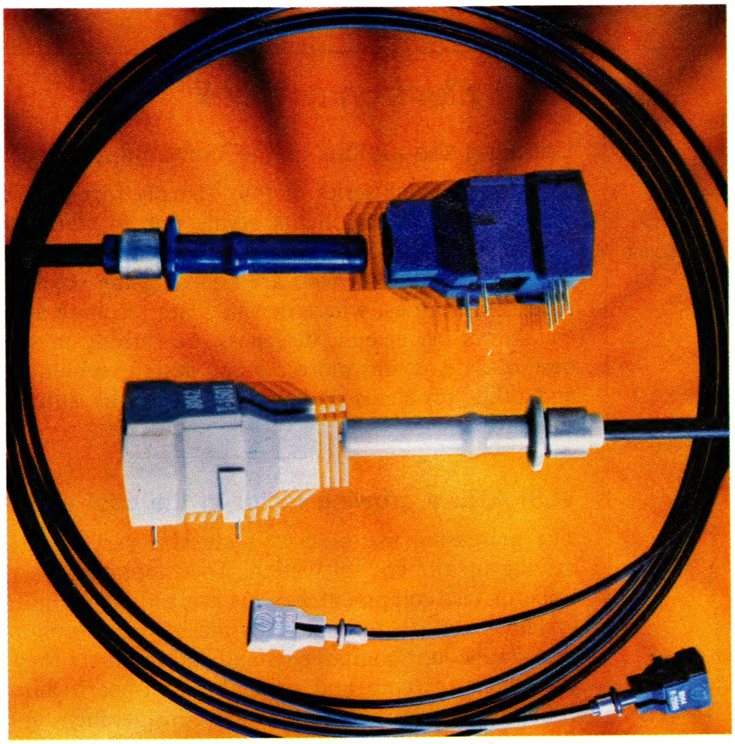

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Next ElectronicsWeek

Updating the picture in the components sector

The third in our series of four sharply focused Technology Update features will cover the components arena, one in which the game is changing. For example, as the demand for increasing functionality continues apace, systems experts are the ones who are choosing the set of features to go onto a chip. And in memories, where densities are reaching a total of more than a million transistors per circuit, designers are turning to sophisticated computer-aided design systems and more regular design techniques. For an analysis of these and other problems and opportunities, the annual Update package sets the standard.

VLSI ATE: a growing factor in the cost equation

The increasing use of large-scale and very large-scale integrated circuits is driving up the cost of testing. To compound the problem, the rapidly rising price of test equipment has hit more than $1 million for a single-device test system. In 1983, to cope with the increased volume and complexity of these high-gate-count components and the products they populate, about $1 billion was spent on chip and printed-circuit-board automatic test equipment. By 1988, the ATE market may be considerably more than 2½ times greater than it was in 1983. Examine its ins and outs in the next *ElectronicsWeek.*

Looking ahead in ElectronicsWeek

Consumer products are coming together

The final installment in the Technology Update series will cover the wide spectrum of consumer electronics. In an area where integration is the watchword—the distinction between audio and video, for example, is beginning to erode—this look at products and design trends is must reading.

October 1, 1984 Volume 57, Number 25
112,914 copies of this issue printed

ElectronicsWeek (ISSN 0748-3252). Published weekly by McGraw-Hill, Inc. Founder: James H. McGraw 1860-1948. Publication office: 1221 Avenue of the Americas, N. Y., N. Y. 10020; second class postage paid at New York, New York and additional mailing offices. Postage paid at Montreal, P. Q. Registration Number 9034.

Executive, editorial, circulation and advertising addresses: ElectronicsWeek, McGraw-Hill Building, 1221 Avenue of the Americas, New York, N. Y. 10020. Telephone (212) 512-2000. Teletype 12-7960 TWX 710-581-4879. Cable address: MCGRAWHILLNEWYORK.

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Service and repair revenues grow steadily/30

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ElectronicsWeek

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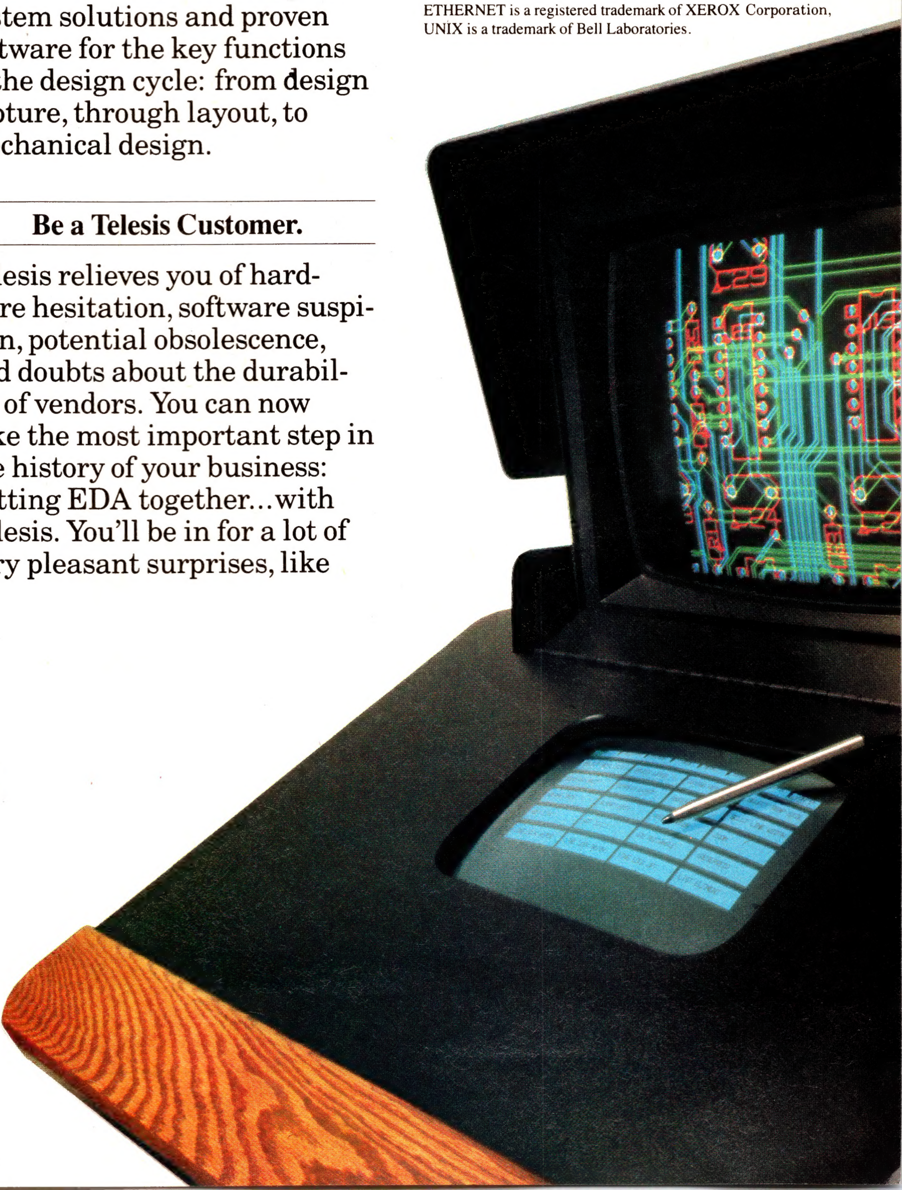

IBM switches gears, decides to buy all of Rolm Corp.

Reversing what appeared to be its trend toward simply investing in smaller high-technology firms, IBM Corp., Armonk, N.Y., last week said it will acquire Rolm Corp. for $1.25 billion in securities. IBM now owns 23% of the Santa Clara, Calif., maker of private automated branch exchanges and other telecommunications equipment. The Rolm acquisition represents IBM's first corporate takeover in 22 years, since it acquired Science Research Associates, a publishing concern, in 1962. Industry observers had wondered, when the U.S. government ended its antitrust battle with IBM, if the computer firm would consider acquisitions. IBM subsequently bought minority parts of some firms, notably Intel Corp. and Rolm, indicating that it would rely on such minority partnerships to shore up some gaps in its product line. Last week's disclosure apparently means that IBM is rethinking that strategy.

AT&T makes comeback in PBX market

With the IBM-Rolm connection more clearly drawing the battle lines between the computer firm and AT&T Co., New York, in the office-automation marketplace, a new report predicts that AT&T may be able to compete more effectively with IBM. After watching its sales slip for more than a decade, AT&T is now poised to become a dominant factor in the PBX market. The study, by Northern Business Information, New York, notes AT&T hit bottom in 1982 with 23% of the PBX market, but its share of the $3 billion market rose last year to 23.6%; this share will climb to about 30% of 1990's projected $5.6 billion market. AT&T's PBX program is defining its office-automation strategy, NBI says, as it adds application processors and integrated voice-and-data terminals to its telecom line. ''In the future, there may be only two major office-automation suppliers, AT&T and IBM,'' the study concludes.

Sweden offers tax breaks to lure foreign scientists

Swedish firms may have a much better chance to hire foreign research and development specialists under a tax-relief plan proposed by a government commission. Swedish companies have long complained that the country's high income taxes made it virtually impossible to hire needed foreign specialists. Now the commission has proposed that only 70% of the salary of a guest R&D specialist be subject to income tax and employer-paid social costs. In addition, there would be tax relief for some cost-of-living extras. According to commission calculations, guest specialists' after-tax net income would then be roughly the same as in such countries as the U.S., UK, and Japan, where income-tax rates are lower.

Micronix, AT&T cross-license X-ray lithography patents

Micronix Corp., Los Gatos, Calif., the first firm to make a commercially available X-ray lithography system, has signed a patent cross-licensing agreement with AT&T, under which both may use present and certain future patents relating to lithographic manufacturing equipment. ''Using several concepts originated by AT&T Bell Labs, our MX series lithography systems are achieving excellent positioning and aligning results,'' notes Micronix president Sam Harrel, who sees a good market opportunity for his firm in the fabrication of future 4- and 16-Mb memory chips, for which X-ray lithography may be the only cost-effective lithography tool.

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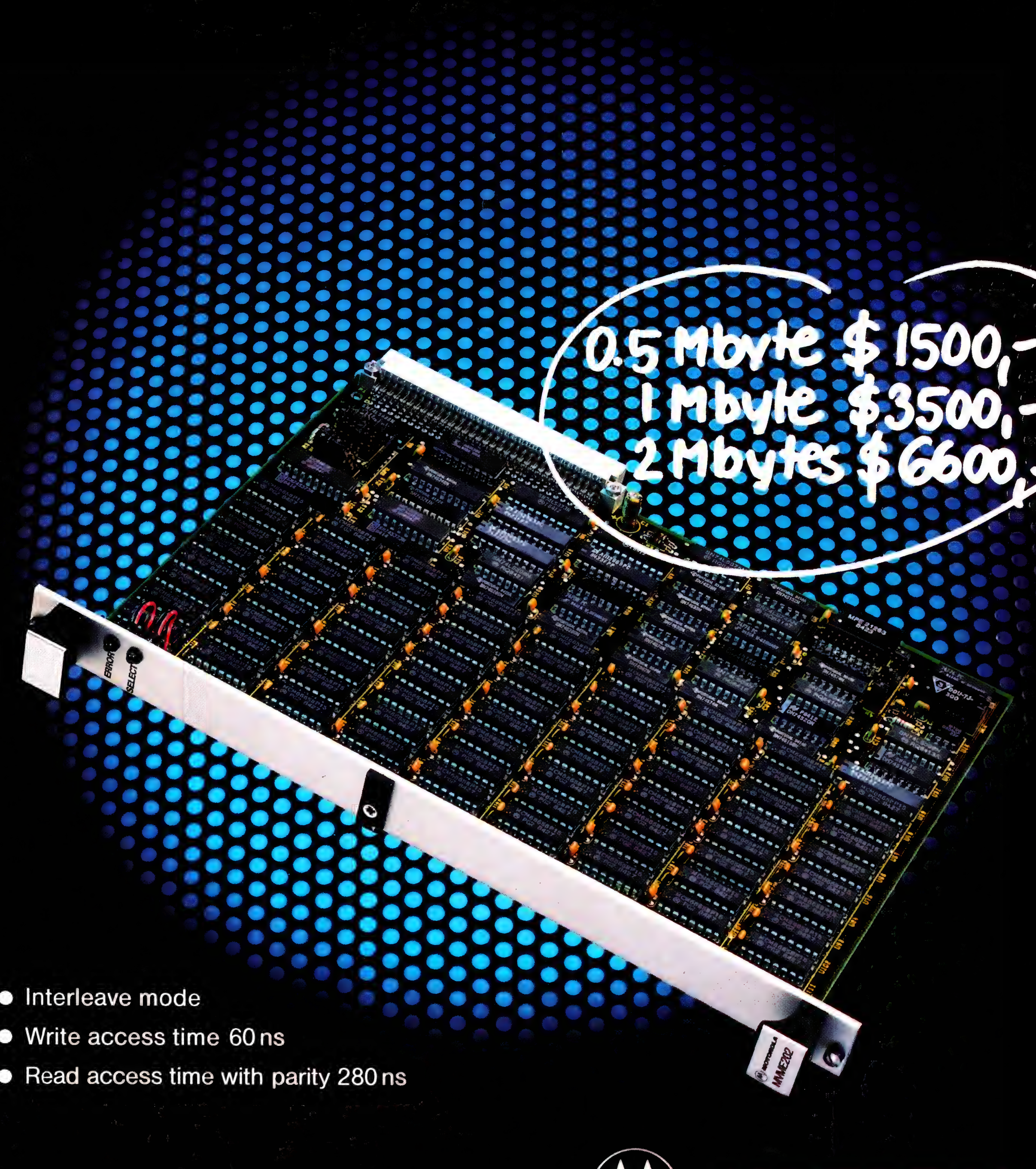

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VMEbus Products from Motorola

PRODUCT REFERENCE	DESCRIPTION
VME/10	
M68K102B2	VME/10 microcomputer system with 15 Mbyte Winchester disk, 655 Kbyte floppy disk, 5-slot VMEbus backplane and 4-slot I/O channel backplane
M68K102C2	As M68K102B2 with 40 MB Winchester
Processor Modules	
MVME101	MC68000 with 256 KB on-board memory space, system controller functions, 1-level bus arbiter, VMEbus interface, parallel I/O, 2 serial I/O ports, timer
MVME110-1	MC68000 with 256 KB on-board memory space, 1-level bus arbiter, VMEbus interface, I/O channel interface, 1 serial I/O port, timer
MVME115M	MC68010 with MC68451 192 Kbytes on board memory
MVME120	MC68010, MC68451, 64 Kbytes ROM area. 128 Kbytes dual ported RAM, 4 Kbytes Cache
MVME121	As MVME120 but with 512 Kbytes RAM
MVME128	MC68010/MC68451, 256 Kbytes dual ported RAM VMXbus interface
Memory Modules	
MVME201	256 Kbytes dynamic RAM with parity
MVME202	512 Kbytes dynamic RAM with parity
MVME222-1	1 Mbyte dynamic RAM with parity
MVME222-2	2 Mbytes dynamic RAM with parity
MVME211	1 Mbyte static CMOS RAM/ROM/ EPROM module
System Controllers	
MVME025	VME system controller
MVME050	VME system controller with memory and I/O

PRODUCT REFERENCE	DESCRIPTION
Peripheral I/O (VMEbus)	
MVME300	IEEE-488 GPIB controller with DMA
MVME310	Universal intelligent Peripheral Controller (UIPC) with free user area
MVME315	Intelligent floppy disk controller and SASI/SCSI interface with DMA
MVME316	VMEbus to I/O channel adapter
MVME319	Floppy disk controller and SASI tape controller interface
MVME320	Winchester/Floppy disk controller
MVME330-UX	Ethernet controller module with UNIX S/W
MVME330-VX	Ethernet controller module with VERSAdos S/W
MVME331	6-Channel intelligent serial communications module
MVME333	4-Channel intelligent high speed communications module
MVME340	64-bit parallel interface module
Peripheral I/O (I/O Channel)	
MVME400	Dual-Channel serial I/O
MVME410	Dual-Channel 16-bit parallel I/O
MVME420	SASI peripheral adapter
MVME435	Buffered 9-track magnetic tape adapter
Industrial (I/O Channel)	
MVME600	16-Channel analog input
MVME601	16-Channel expansion for MVME600
MVME605	4-Channel analog input
MVME610	120V/240V 16-Channel AC input
MVME615	120V/240V 16-Channel AC output Zero cross-over switching
MVME616	120V/240V 16-Channel AC output Non-zero-cross-over switching
MVME620	30V DC input
MVME625	30V DC output

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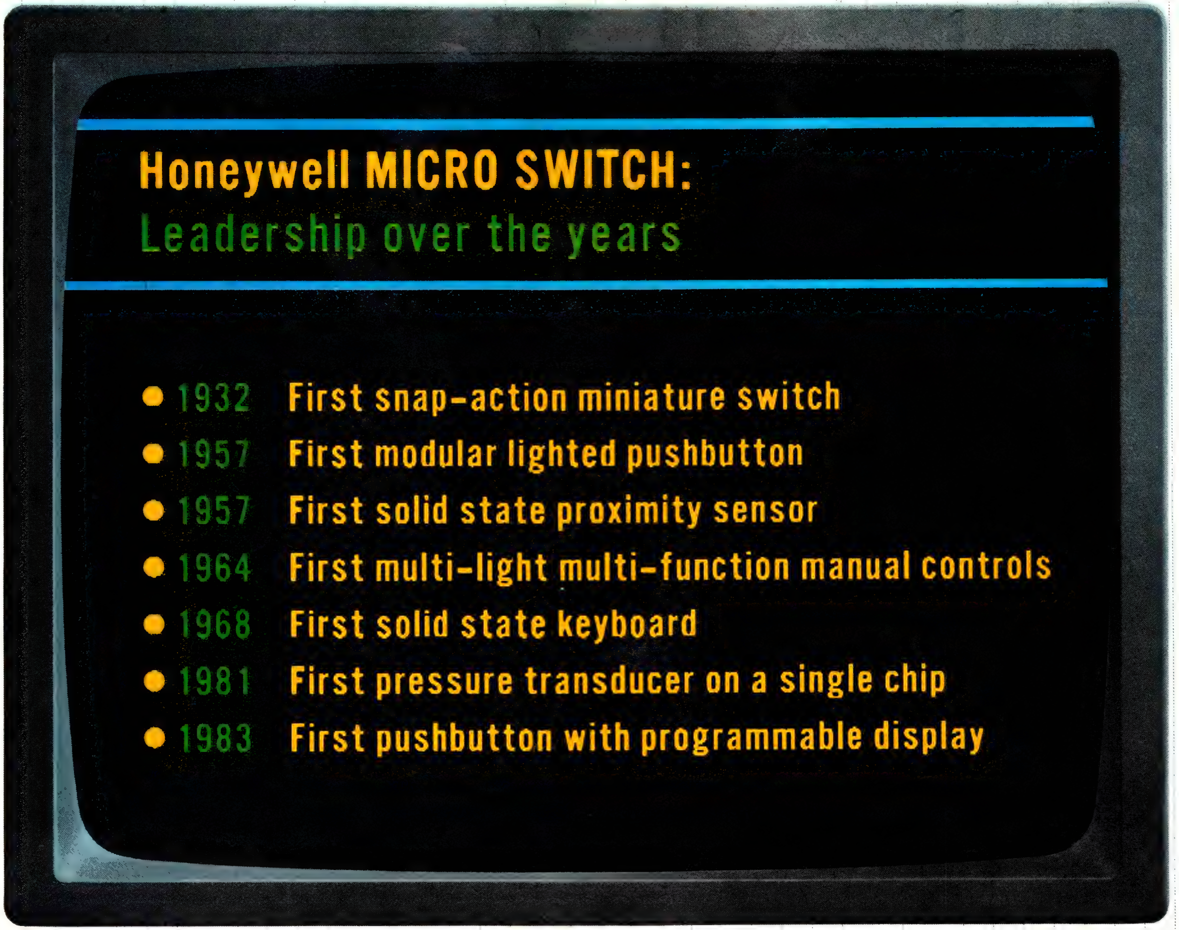

Honeywell MICRO SWITCH:
Leadership over the years

- 1932 First snap-action miniature switch
- 1957 First modular lighted pushbutton
- 1957 First solid state proximity sensor
- 1964 First multi-light multi-function manual controls
- 1968 First solid state keyboard
- 1981 First pressure transducer on a single chip
- 1983 First pushbutton with programmable display

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Circle 97 on reader service card

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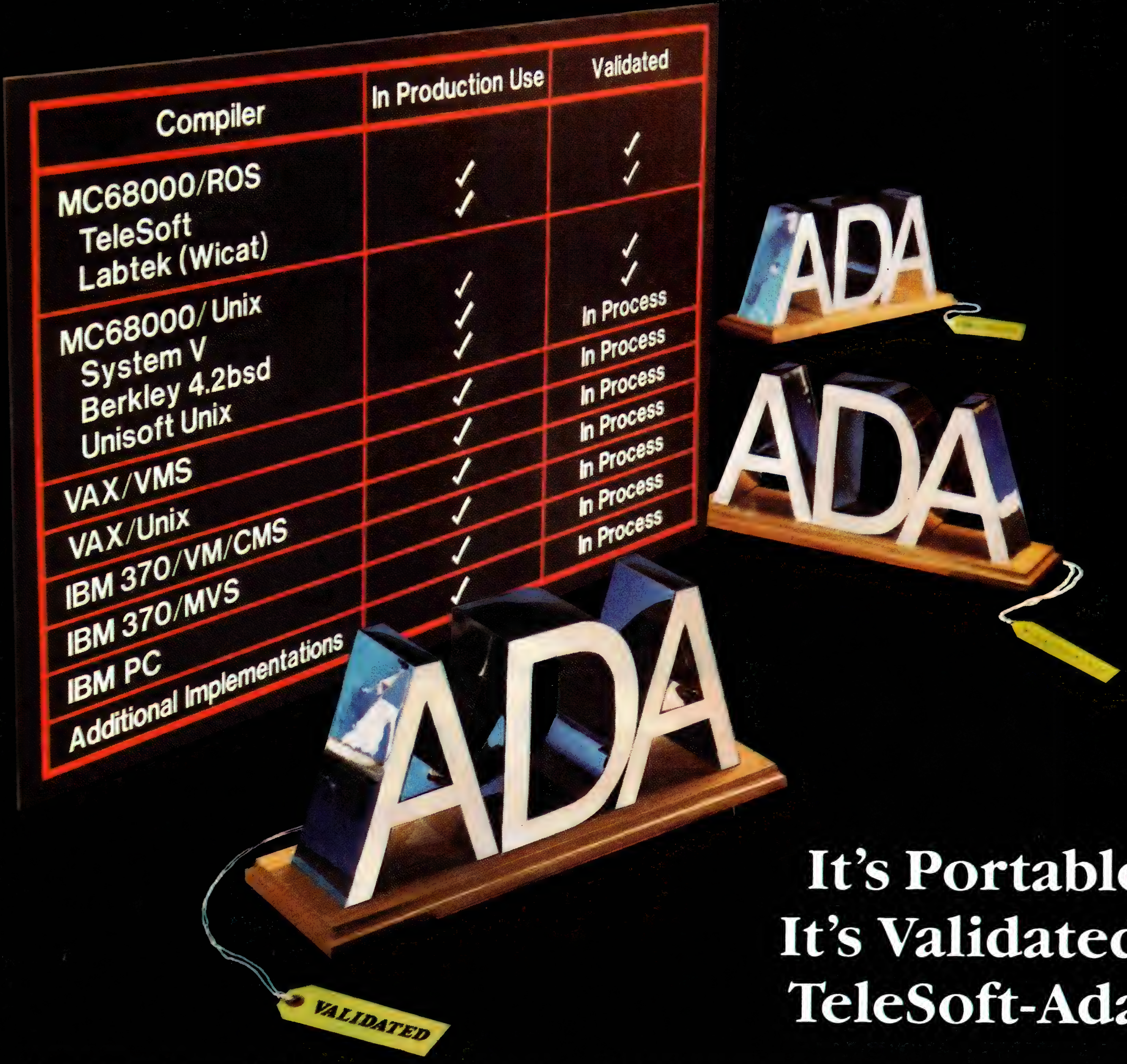

Compiler	In Production Use	Validated
MC68000/ROS		
TeleSoft	✓	✓
Labtek (Wicat)	✓	✓
MC68000/ Unix		
System V	✓	✓
Berkley 4.2bsd	✓	✓
Unisoft Unix	✓	In Process
VAX/VMS	✓	In Process
VAX/Unix	✓	In Process
IBM 370/VM/CMS	✓	In Process
IBM 370/MVS	✓	In Process
IBM PC	✓	In Process
Additional Implementations	✓	In Process

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Circle 10 on reader service card

BURIED OXIDE MARKS ROUTE TO SOI CHIPS

Texas Instruments sees high promise for oxygen-ion implants as a practical way to fabricate wafers with an insulating layer below the active silicon ☐ *By J. Robert Lineback*

Dallas, Texas

Exploring a technology roadmap that jams more transistors into a given area and places complementary-MOS firmly in the fast lane, researchers at Texas Instruments Inc. believe they are approaching a practical oxide-insulator alternative to expensive silicon-on-sapphire wafers.

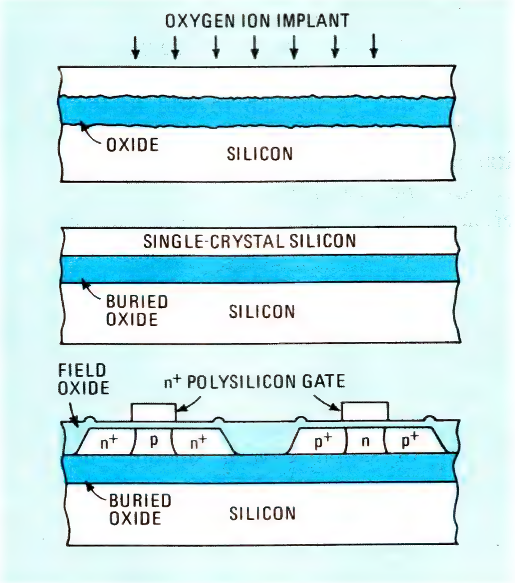
In this effort, TI has plenty of company. Industrywide, laboratories are racing to develop a low-cost silicon-on-insulator technology to unseat SOS as the best candidate for ultra large-scale integrated circuits, like 16-Mb random-access memories.

SOI research is driven by the high cost of SOS, which now runs about $80 per 4-in. wafer compared to $12 per wafer for a comparable bulk silicon slice. Like SOS, SOI technology allows tighter packing densities by eliminating the need for space-taking dioxide isolation between on-chip transistors. SOI devices are radiation-hard, as well. And the oxide insulator has a much better interface with silicon than does sapphire, resulting in lower device-leakage currents and higher carrier mobility.

Plenty of paths. Exploratory paths to SOI are numerous, and include silicon recrystallization by annealing deposited polysilicon, oxygen ion implantation, and porous oxidation of silicon. Several major semiconductor labs in the U.S. and Japan are pressing on most known fronts. Not wanting to be left behind, a research cooperative in Britain is exploring four separate routes at once [*ElectronicsWeek,* Aug. 6, p. 31].

It is the kind of research and development race requiring agility for the sharp turns in directions and an eye on the distant horizon, hints Dennis Buss, director of TI's Semiconductor Design and Process Center. While describing the firm's CMOS technology research, Buss recently reviewed progress in SOI as well as three-dimensional integration for high-density static and dynamic RAMs (see "Polysilicon sandwiches for 3-d circuits," p. 12). Oxide-insulator progress has been promising enough that TI believes SOI could play a key role in the 0.5-μm phase-2 of the Pentagon's Very High-Speed Integrated Circuit program.

SOI has been researched at TI since the 1960s, but it has not yet made it out of the lab into the real world. Advances in processing technology will likely change that by the end of the decade. Two years ago, TI was in hot pursuit of SOI using graphite-heater annealing of polysilicon atop recessed oxide [*Electronics,* June 2, 1982, p. 45].



In deep. Implanted oxygen ions form a buried oxide layer, but damage the silicon. Annealing creates a single-crystal layer for devices atop the insulating oxide.

Changed focus. But last year, the Dallas chipmaker refocused its attention to ion implantation of buried-oxide SOI, which has its roots in basic research performed 15 years ago. "The quality of silicon is better, and it is appears to be less expensive—more suitable for manufacturing," says Buss.

The promising SOI process implants oxygen ions into silicon, burying a layer of insulating oxide beneath its surface. The ions travel too rapidly to damage the single-crystal silicon at the surface. The lattice, however, is damaged in areas where ions come to rest. The heavily implanted layer—2 × 10^{18} ions/cm^2—is then annealed at 1,150°C for 2 hours to form a sandwich of single-crystal silicon, a buried middle layer of oxide, and a silicon substrate.

To demonstrate the manufacturability of the experimental SOI technology, TI's semiconductor lab in Dallas has fabricated 4-K static RAMs using conservative 2.5-μm C-MOS. The chips are showing 55-ns access times, the comnpany says.

The lab is now preparing to make a more ambitious 64-K static RAM. Right off the bat, lower capacitance in the source and drain junctions of SOI chips promises 30% better access speeds over today's fastest bulk-silicon MOS memory products.

But what is needed before the SOI technology can move onto the production floor are ion implanters with current 10 times higher and one third more voltage than existing systems, says Buss. "We are talking about high-current implanters in the 100 to 200 mA range," he says, adding that the needed systems are likely to become available in two or three years. Using the 10-mA implanters, it takes an hour to bury the proper amount of ions.

Voltage levels of current implanters bury ions only 0.4 μm deep, requiring the lab to add to the thickness of the top silicon layer by an epitaxial growth using chemical vapor deposition.

The SOI 4-K static RAMs are showing the carrier mobility of bulk silicon, reports Buss, while leakage is much lower than SOS. The chips show a leakage of only 0.1 pA/μm at 5 V.

"SOS will range between 10 to 100 pA/μm because of the poor interface of sapphire with silicon," he says. "We expect the first application for buried-oxide SOI to be in radiation-hard military products, but the larger impact is going to be in high-performance microcomputers, such as single-chip digital signal processors for the video band."

Polysilicon sandwiches for 3-d circuits

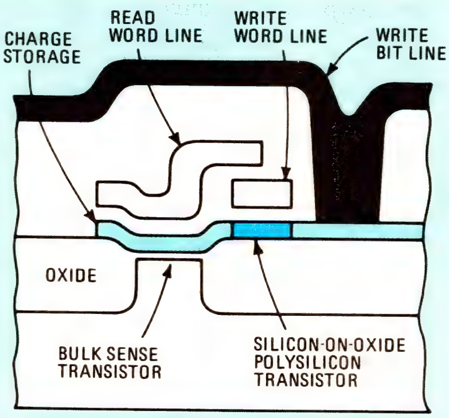
In the long run, silicon-on-insulator substrates may turn out to be one of the best vehicles to carry solid-state integration into the third dimension. Real estate could be saved by stacking circuits made in two layers of single-crystal silicon separated by an oxide insulator.

That is still some way off. Meanwhile, researchers at Texas Instruments Inc. in Dallas are finding success with a possible near-term technology. It places transistors with lower performance requirements in a thin layer of polysilicon. These thin-poly transistors are then placed on top of conventional bulk-silicon transistors.

With currently available processing techniques, 3-d integration with polysilicon appears to be easier than using the two single-crystal layers of SOI. TI designers have already made two types of experimental 64-K chips to test the reliability of thin-poly transistors for high-density memories.

For dynamic random-access memories, TI scientists are convinced that one-transistor memory cells—the industry workhorse since the 4-K generation—will not be viable at 4-Mb densities. Such cells, they believe, would either result in huge dies (approaching 200 mils^2) or require minimum features so tiny that capacitance levels would fall victim to alpha-particle strikes. Even trenched capacitors may not help DRAM designers achieve cost-effective dies, speculates Dennis Buss, director of the TI Semiconductor Design and Process Center in Dallas.

Therefore, the lab is experimenting with what it calls 3-d transverse-injection, two-electrode (TITE) RAM circuits. They are similar to the floating-gate cells used in erasable programmable read-only memories. However, the TITE RAM has an additional transistor in thin-poly (see figure). It controls the writing charge to the storage mechanism, a stretched floating gate. In EPROMs, avalanche current is used to tunnel carriers into the floating gate. In both memories, a charge in floating gates alters the threshold of cells indicating a bit of data.



The TITE RAM promises to reduce space requirements by two to two and a half times over conventional single-transistor DRAM cells, says Buss, adding that the concept is still in development and considered a strong candidate for 4-Mb circuits. The lab is now testing 64-K TITE RAMs.

In the static arena, TI researchers have produced an 8-K-by-8-bit RAM employing a new stacked complementary-MOS circuit. Each static-RAM cell has two of its six transistors made in thin-polysilicon. The result is a space savings of 30% to 40% over conventional circuits, says Buss. Because carrier mobility in polysilicon is 10 times worse than in bulk silicon, only the p-channel pull-up transistors are made in the second layer, stacked above higher-performance n-channel drivers.

To reduce current leakage and lower MOS thresholds in the polysilicon, TI passivates it with hydrogen. Such passivation ties up the dangling bonds of the particles in polysilicon, reducing the surface charge. **-J. Robert Lineback**

GATE ARRAYS

ECL/TTL arrays start turning up

Los Angeles—A fact of life in the hard-charging semiconductor business—where most key people have known each other for years—is that when a hot new chip appears, it pops up simultaneously at other firms. A fresh example can be noted in the youthful bipolar-gate-array business, where three firms are shipping samples of a nearly identical new part.

The big attraction of these macro arrays is that they may operate either in the emitter-coupled-logic or TTL mode, or in both at the same time. Their advantage is in providing on a single chip the fast ECL performance, while directly interfacing to TTL or MOS circuits, or both. To combine ECL speed with an interface to TTL currently requires a number of discrete translator devices, which are expensive and also clutter up circuit boards.

The potential for these arrays is enticing enough that two semicustom firms have introduced them, and a heavyweight standard-products semiconductor maker is gingerly testing the water with a yet-to-be-announced product. All of these use recent oxide-isolating processing techniques, which get the best bipolar speed and require the least power.

While all three currently are offering samples for customer evaluation, Applied Micro Circuits Corp. in San Diego, Calif., actually went public first, with its Q3500 array [*ElectronicsWeek*, Aug. 13, 1984, p. 68]. Vatic Systems Inc., Mesa, Ariz., introduced its V1200 and V1700 macro arrays in mid-September.

Meanwhile, Advanced Micro Devices Inc., the established Sunnyvale, Calif., chip maker, has not formally dealt itself into this semicustom game, but acknowledges having an 1,800-gate version that it is quietly showing to prospective large-value customers. AMD is keeping a "real low profile," with its first proprietary semicustom part, says David Laws, managing director for programmable logic products.

Gained experience. AMCC's Q3500 has the equivalent of up to 3,500 gates, with gate delays from 275 to 700 picoseconds. Its power consumption is 3.5 W, or 1 mW per equivalent gate. The firm claims credit for pioneering the ECL/TTL mixed array in an earlier Q700 and Q1500 series that was fabricated with slower, more power-hungry junction-isolated techniques. "But the experience enabled us to cut our teeth and get well down the learning curve," according to Marc Friedmann, strategic marketing manager.

At Vatic Systems, the new macro arrays have equivalent internal gate delays of 800 ps at 1 mW/gate. They are implemented in a two-metal process, and are composed of two basic cells, logic and input/output. Universal I/O cells on the periphery of the arrays provide all buffering and drive functions, along with TTL/ECL-level translation for external interface to both types of circuitry.

Close ties. Typically, close ties exist between these array firms. The executive lineup at Vatic Systems includes Harold H. Muller, president, Charles Parr, director of marketing, and others who came directly from Motorola Semiconductors' Bipolar Division, the industry sales leader in gate arrays. In addition, vice president of engineering M. Nghiem Phan previously was a designer at AMCC. Officials at both firms are also longtime friends of Laws at AMD.

Although no joint planning of array developments is in the works, the strategy is for no firm to get too far afield from what the others are doing. All parties, for instance, are very curious about Motorola's 2900 mixed ECL/TTL array. For its part, Motorola says the Model 2900ETL will be its next major move in bipolar macro arrays, but the introduction of the part is not planned until mid-1985 because of heavy demand for existing ECL and other devices.

One murky topic for macro arrays is pricing. Marketing officials do not want to be pinned down at this stage, claiming that various packages and specific applications would make any figure misleading. One source, however, gives the range at $25 to $50, depending largely on the type of packaging. **–Larry Waller**

MILITARY

Ada software gets off ground as jet flies under its control

Irvine, Calif.—Ada, the Defense Department's valiant attempt at a standardized programming language, has literally gotten off the ground. An Air Force F-15 jet fighter was successfully flown last month under the control of an on-board digital flight computer with programs written in Ada. It was the first such mission-critical test for Ada software.

The DOD wants to make Ada its standard language for embedded systems, but development of the language has been slow because of the difficulty of standardizing something as volatile as a software language. The software compiler being used in the Ada test has not yet been validated as meeting the standardization requirements.

Its creator, Irvine Computer Science Corp., Irvine, Calif., has concentrated on the compiler's performance, rather than its compliance with DOD standards. Code generated by the compiler for the flight test had to execute fast enough to allow the processor to make 80 system checks per second.

"Flying Ada in a flight-critical system will be viewed by both the aeronautical and avionics communities as a crucial step that had to be taken in order for Ada to be implemented operationally," maintains Morris Ostgergaard of the Air Force's Flight Dynamics Laboratory, which is part of the Air Force's Wright Aeronautical Laboratories. The Flight Dynamics Laboratory conducted the flight tests jointly with McDonnell Aircraft Co., part of McDonnell Douglas Corp., St. Louis.

"It's certainly a nice milestone in the Ada program," agrees Daniel R. Eilers, president of Irvine Computer. "When people hear that Ada works for accounting, they yawn, but when they hear that it flew an airplane, they will sit up and take notice."

To be accepted as an official DOD Ada compiler, machines must successfully compile a "validation suite" of some 2,000 Ada programs. So far, an interpreter from New York University and compilers from the Rolm Corp., Western Digital Corp., and Telesoft have sucessfully passed the test. There are no speed requirements in the validation suite.

"We expect our compiler to validate eventually," Eilers says. "It's arguable which is easier, to focus on performance first or to concentrate

Ada aloft. An Air Force F-15 jet fighter was successfully flown with its on-board computer running programs written in Ada, the Defense Department's hoped-for universal software.

on meeting those 2,000 tests. The irony of validation is that if you spend all your time on those tests, you can forget about performance. The other compilers would not yet be capable of flying an airplane."

The Irvine Computer compiler has been rewritten for eight processors, including the 16-bit Z8002 chip made by Zilog Inc., Campbell, Calif. There are four Z8002s, two for pitch control and two for yaw and roll, in the F-15 flight computer.

Substitute. The computer was built by the Astronics Division of Lear Siegler Inc., in Santa Monica, Calif., for the Digital Electronic Flight Control System (DEFCS) on the F-15. A direct replacement for the F-15's currently operational analog system, the Lear Siegler equipment monitors all sensor inputs and responds with output control signals to its actuators 80 times a second.

"The flight went very well, everything was normal," says Theodore Westermeyer, head of advanced engineering for McDonnell Aircraft. "It compared favorably with the standard F-15 flight control system."

There were actually four flights, the first of a planned series of 17, out of Edwards Air Force Base, Calif. In the initial tests, the plane was restricted to hour-long flights at low altitudes at Mach 1.2. "These were essentially shakedown flights," Westermeyer said. "Later we will fly faster, higher, and farther."

Flight control programs are burned into programmable read-only memories. The computer has 27-K bytes of internal memory, of which the initial flight program used only about 5-K bytes. The DEFCS had been tested previously with code generated from source written in Pascal; the speed of the Ada code was comparable to that of the Pascal code, Westermeyer said. Eilers said the Irvine Computer-compiled code executed a command loop in 8 ms, rather than the 12.5 ms allowed.

The Irvine Computer compiler consists of two programs. A front end analyzes the source code and generates an intermediate representation. A second pass turns the intermediate code into machine code for a particular processor [*Electronics*, July 14, 1983, p. 49].

"Irvine Computer has a production-quality Ada. It's always been an issue in the industry, that the compiler produce code that is a substitute for assembly language," notes John Johnen, manager of software marketing for Zilog. "We have been working with them for two years to create an Ada implementation that can actually be used, in that it will produce an efficient code, in embedded applications."

According to Johnen, the flight system was the first such implementation. Validation, he adds, would not be difficult to achieve, because all of the functions that are used in the flight system have met the validation tests. **–Clifford Barney**

PRINTERS

Nonimpact printer has LCD shutters

Tokyo, Japan—The newest nonimpact printer from Japan looks like a tabletop office copier and behaves (almost) as if it works with laser-beam technology. In reality, the liquid-crystal shutter printer passes light through a linear array of shutters to write text and graphics on the photoconductive drum from which they are printed.

Casio Computer Co. has announced such a product, with deliveries scheduled for next spring at a sample price of $1,625. It features a printing density of 9.45 dots per mm, a throughput of 9 pages per minute for metric A-4 or letter-size paper, and the ability to handle pages from postcard to metric-B-4 in size. Another firm, Suwa Seikosha Co. in Suwa, has long been developing liquid-crystal shutter printer technology [*Electronics*, May 5, 1982, p. 63], and announcement of a similar product is expected before year-end from its production affiliate, Epson Corp., in Shiojiri.

Related by television. Liquid-crystal shutters are similar to liquid-crystal displays and are used in the 2-in. LCD color television sets recently brought to market by Epson. Casio engineers say that the shutters in the firm's printer have a response time of only 0.5 ms, which they claim is 100 times faster than the shutters in the TV, but only twice as fast as the shutters in the earlier experimental Suwa system.

The shutters are arranged in two staggered rows to facilitate high density and ease of connection to driving circuits (see diagram). A linear array of fiber lenses—short lengths of graded index optical fibers that have the same focusing properties as small, conventional lenses—convert the staggered array to a single line. (One end of the row of fiber lenses is in a staggered array to match the shutters; the other end is in a straight row.)

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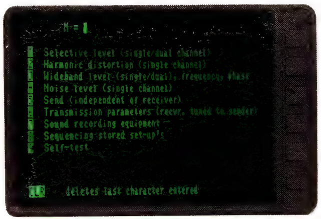

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M =
Selective level (single/dual channel)
Harmonic distortion (single channel)
Wideband level (single/dual), frequency, phase
Noise level (single channel)
Send (independent of receiver)
Transmission parameters (recvr. tuned to sender)
Sound recording equipment
Sequencing stored set-up's
Self-test

deletes last character entered
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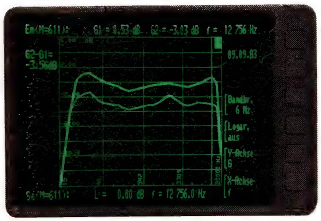
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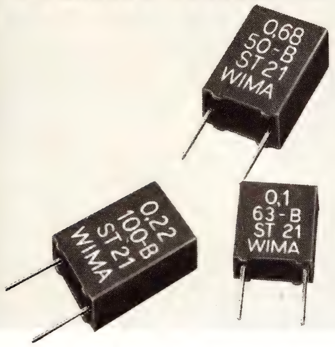

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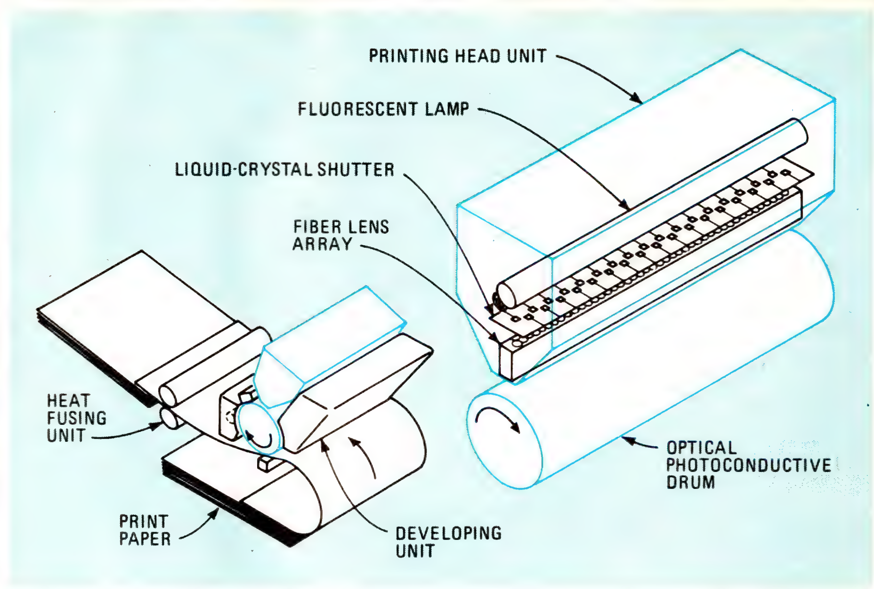

A staggering array. The shutters in Casio's printer are arranged in two staggered rows in order to facilitate high density and ease of connection to driving circuits.

ganic photoconductor drum is used to keep printer size small and performance high. The light source is a conventional fluorescent lamp used in copiers. As in laser printers, the liquid-crystal shutter printer develops the electrostatic image on the drum with a fine-grain toner mixed with a powdered carrier, transfers the image to plain paper, and fixes the image by thermal fusion. Neither speed nor resolution is as high, however.

The Casio printer's standard configuration includes a video input interface. It comes with a bit-mapped full-graphic memory for metric B-4 pages. With optional Centronics parallel and RS232C serial interfaces, the printer can be used for documentation that requires graphic or pattern printing or form overlays.

Light-emitting-diode array printers have been developed experimentally for facsimile, but they appear less practical. For one thing, liquid-crystal shutter arrays can be fabricated in a batch process, while LED arrays cannot. Moreover, liquid-crystal shutter arrays behave as capacitive loads that absorb negligible driving power, although the C-MOS driving circuits typically dissipate two or three watts. LED arrays typically dissipate 10 watts, while their driving circuits dissipate perhaps half as much for a total of somewhat less than 20 W. **–Charles L. Cohen**

COMPUTER SECURITY

Treasury's EFT security mandate hailed as a banking landmark

Washington—Once again, Uncle Sam is leading the way toward the improvement of computer security in the U.S. A new Treasury Department directive gives all public and private institutions that do business with the U.S. government four years to begin using a National Bureau of Standards system that protects the integrity of the messages that are used in electronic funds transfer.

The initiative is no less than "the most important development in banking since the invention of the combination lock," declares Blake Greenley, a vice president with New York's Citibank, which plans to adopt the new security system as soon as possible. Close on its heels are five other banking giants: Chase

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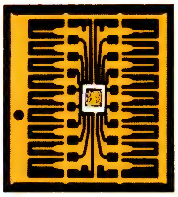

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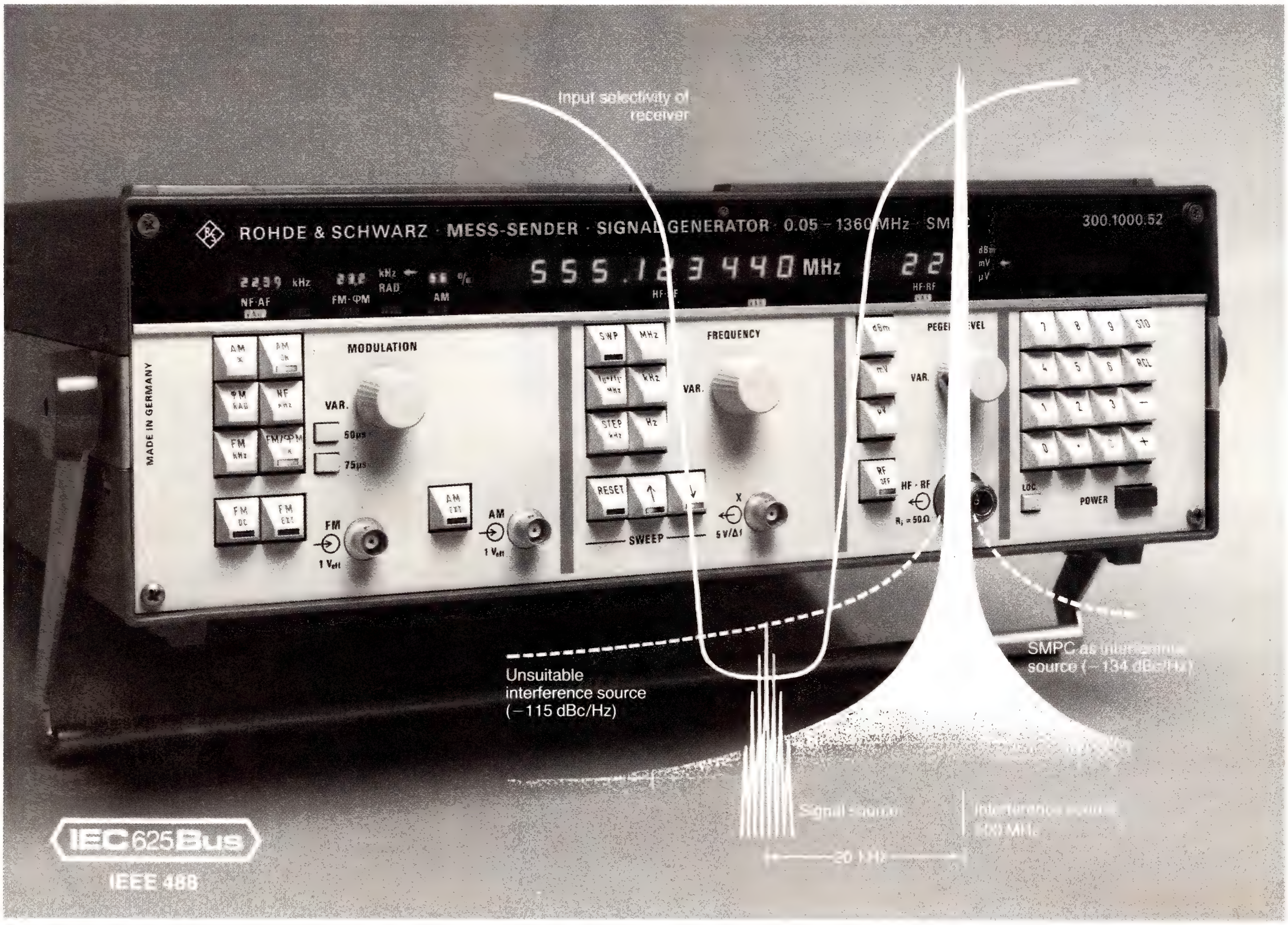

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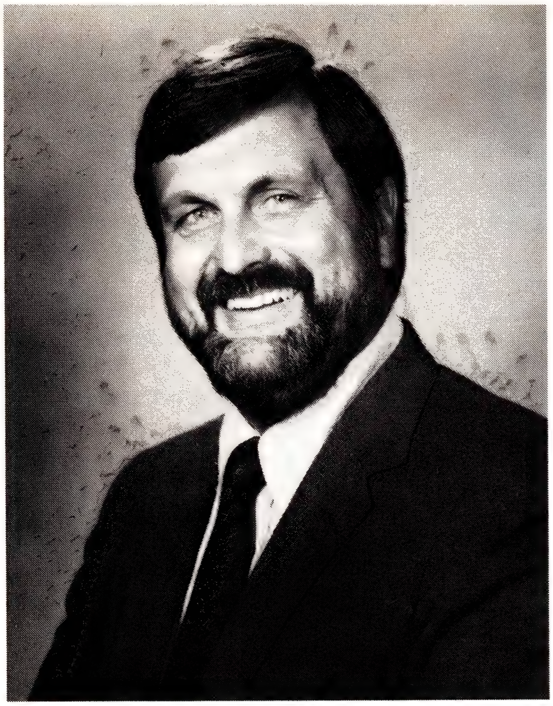


Key is the key. The security of the new ETF scheme depends on having the correct secret key at the transmitting and receiving ends, says Dennis Branstad, of the NBS.

Manhattan, Chemical Bank, Manufacturers Hanover Trust, the Bank of America, and Security Pacific Bank. The N.Y. Clearing House is already running the system to produce $300 billion worth of EFT wires a day. As for the Treasury Department itself, yearly EFT values run into the trillions.

But the greatest impact will be on the nation's 14,000 small to medium-sized banks, argues William Krowell, who wrote the agency's directive while he was a Treasury assistant secretary. "Until now, these banks have not had much incentive to protect EFTs in a technological sense." The Treasury Department's policy ensures that these banks will come on board with state-of-the-art protection fairly quickly, he adds.

Deadline is 1988. As spelled out by the directive, all terminals that send and receive EFTs must conform to two American National Standards Institute standards by 1988. These are X.9.9, an authentication standard developed two years ago, and X9.17, a cryptographic key-management system being put into final form for commercial distribution by the end of the year.

Before sending an EFT, the system will compute a message authentication code (MAC) onto the message by dividing it into blocks of eight ASCII characters, explains Dennis Branstad, manager of data security and integrity technology at NBS and one of the architects of the ANSI standards.

The first string of eight characters is run through the Data Encryption Standard (DES) algorithm using a secret key known only to the sender and receiver. The output of the DES is then added to the second block of eight characters, after which the result is run through the DES and is encrypted again. The process of adding DES output to the next block of characters and encrypting it continues until the last block is encrypted. The first eight hexadecimal characters of the final DES output—a 32-bit word—constitutes the MAC.

The receiver of the encrypted EFT message computes a test MAC and compares it with the MAC produced by the transmitter. If the test MAC is identical to the transmitted MAC, the receiver knows the message is genuine and proceeds to transfer the funds. If the MAC is a fake, the message is rejected and the transmitter is notified.

"The key to the system's security hinges on having the correct secret key at both the transmitting and receiving end," Branstad says. The soon-to-be-released 180-page X9.17 provides an electronic means for secure key distribution, which today is done manually at great cost.

The gist of the standard, he says, is to have a secure computer that doles out keys to EFT senders and receivers certified to conduct two-way transactions. The Federal Reserve Bank is the most likely home for the computer, which should be working in two to three years.

For vendors of security hardware and firmware, the Treasury Department policy could be a long-awaited boost to business. Where the market was once limited to a few concerned banks, it now embraces every government agency, bank, and securities house in the nation, notes Sandy Epstein, of Analytics Communications Systems Inc., a Reston, Va., maker of security systems.

"What we are looking for is demand from institutions with just a few terminals [as well as from] those fielding up to a 30,000-terminal network." That translates into a market in the hundreds of millions of dollars, he adds. **–Karen Berney**

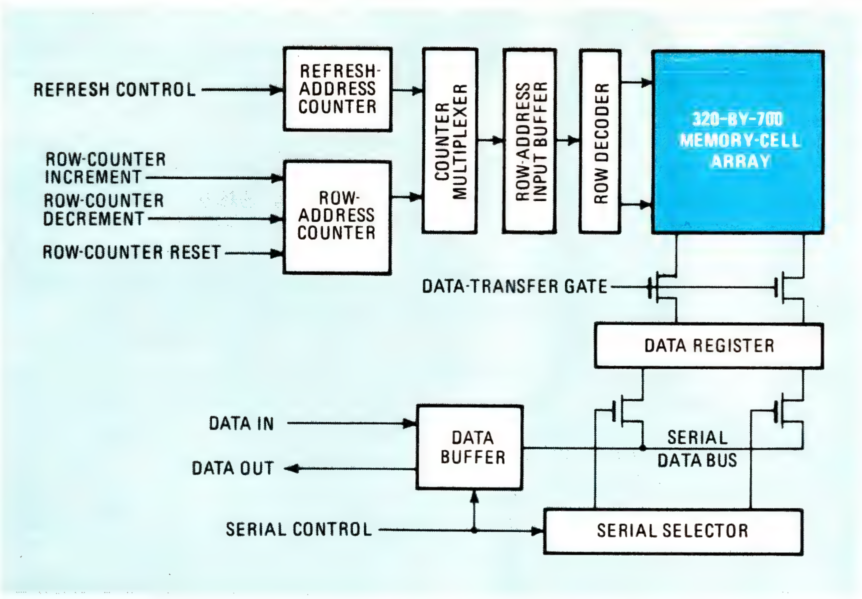
MEMORIES

NEC maps TV image field in low-cost memory chip

Kawasaki, Japan—TV set makers long ago realized they could work marvels if they could incorporate a memory storing a screen's worth of image information in their receivers. But such a store built around standard random-access memory chips would require some 3 megabits of memory, making it much too expensive for consumer equipment.

Now, less costly stores are in sight. NEC Corp. has started sampling a field-memory chip for TV that should cause set makers around the world to rethink their top-of-the-line equipment. Eight chips, each of which should eventually sell for about the price of a 256-K dynamic RAM chip, have enough capacity for a store.

Risky business. Because the field-memory chip could not be springboarded off standard RAMs, NEC had to take a risk on a new design for a chip that needs high speed, is adaptable to a range of television standards, and is low in cost, points out Shigeki Matsue, assistant general manager of NEC's 1st LSI Division. Rather than a power-of-two layout,



Unusual array. The field-memory cell array has a 320-by-700 layout for a 1:1 match between cells and image pixels. Addressing is done by incrementing, decrementing, or resetting rows to zero. The data register and serial data bus convert from parallel to high-speed serial output.

the chip has 320 rows by 700 columns, so that the memory cells and the pixels on the picture-tube have a 1:1 relationship. A complete field memory with the usual 8-bit amplitude range can be assembled from eight memory chips and a few control chips.

Matsue expects a large market for the chip because it can be used in both TV sets and video cassette recorders, which are independent markets. In TVs, field memories can yield many improvements, including noninterlaced scan, higher field rates (for European sets), superior color demodulation, still pictures, windows, zoom, and noise reduction. In VCRs, they can provide still pictures superior to those obtained today by scanning stationary tape, as well as jitter correction and other features. They can be used in video disk players with similar results.

RAMs a poor match. The only other chip built especially for this purpose so far is an N.V. Philips serial charge-coupled device. It has a fixed-length register and thus no flexibility. Dynamic RAMs designed for computer applications are used in professional equipment, but their specifications do not provide a close match to requirements.

RAMs have cycle times much slower than the 70 or 90 nanoseconds required in this application, as well as unwieldy configurations (for a field store). It becomes necessary to divide the memory into interleaved banks, as is done in large mainframe computers, to obtain the required memory bandwidth. Moreover, much storage capacity goes unused: typically, it takes six 64-K RAMs to do the same job as one of the new chips—which have a capacity of 224-K.

Matsue says that the firm worked closely with customers to develop a universal chip that can be made economically using 256-K n-MOS DRAM technology. The 320 rows provide a slight margin over the 313 lines in a European standard (PAL or SECAM) TV field. The 700-bit column dimension is adequate for most TVs, and two chips can be used in an interleaved configuration to provide 1,400 bits for extremely high-resolution displays. Conversely, the peripheral circuits are designed so that the chips can be operated at any number of rows or columns less than the maximum.

The TV field memory is fabricated on the same production lines as 256-K DRAMs, and the cells are similar. Peripheral circuits differ from those of standard RAMs and weren't packed tightly for this first iteration of this type of chip, so the 5.6-by-8.0-mm chip is somewhat larger than NEC's 37 mm² 256-K DRAMs. Thanks to simplified addressing, the chip can be packaged in 14-pin dual in-line packages.

The field memory's addressing in no way resembles that of standard RAMs because TV memories operate with sequential addressing of each row and then sequential readout of bits (columns) in a row. Rows correspond to individual scanning lines, bits to points on the line. Row selection is provided by incrementing, decrementing, or resetting to zero the row-address counter. A second counter addresses the row lines to provide asynchronous refresh.

Clocked transfer. Before readout, all bits on a row are transferred simultaneously into a data register during the horizontal blanking interval. Then a clocked serial selector reads out individual bits in sequence onto a serial data bus and into a serial buffer (see figure). At the end of the line scan, which corresponds to the beginning of the horizontal blanking interval, the data register is read back into the memory to restore the row from which it was read. Before the end of the blanking interval, the row-address counter is incremented and the data from the next row transferred to the register.

NEC's short-term production target for the field memory, designated μPD41221C, is 200,000 chips a month. Sample price for a chip with a 70-ns cycle time is $24.50, that for one with a 90-ns cycle time is $20.40. In mass production, the chip should sell for about the same price as a 256-K DRAM, now selling for about $12 and expected to slide to $8 next year.

–**Charles L. Cohen.**

R&D

Belgians set up advanced IC lab

Leuven, Belgium—Belgium's electronics industry is about to get a potent shot in the arm. The means is a state-of-the-art research laboratory for which ground has just been broken on the campus of the Katholieke Universiteit Leuven. Called IMEC, an acronym for Interuniversity MicroElectronic Center, the laboratory is slated to begin operation as early as January 1986.

IMEC is part of a broad-scale electronics initiative fostered by the government of Belgium. Researchers working there will concentrate principally on developing integrated-circuit technologies, including design methods for very large-scale ICs, connection techniques, optoelectronic components, surface acoustic-wave devices, sensors, and the training of VLSI designers.

Multiple programs. The government has already introduced a program called Invomec to provide advanced microelectronic and VLSI system design training to employees of Belgian companies. It is also operating a center called Inventive Systems, whose goal is to make small and medium-sized businesses aware of the potential improvements that microelectronics offer their products and production processes.

To give IMEC a running start, much of its key personnel will initially come from the Katholieke Universiteit Leuven's prestigious electrical engineering department. Employees will number approximately 150 at the outset, rising to double that figure by 1990. Its facilities will include some 3,900 square meters of ultraclean semiconductor processing area, a 300-m^2 computer room, and a 6,700-m^2 administrative and supporting laboratory space.

Roger Van Overstraeten, the university's former department director, who has taken over as general director of IMEC, points out that the laboratory's objective is to optimize the electronics research done at Belgium's three Flemish-speaking universities, the other two of which are located at Ghent and Brussels. (Belgium, which has two official languages—Flemish and French—also has a dual university system.)

"Given the amount of investment required, it is out of the question for us to have more than one laboratory such as this," admits Van Overstraeten. "And since it is difficult to imagine how you can have a strong electronics industry without high-level research in microelectronics, you can see just how important IMEC could be for Belgian industry."

A substantial portion of the IMEC project will be self-funded. The initial cost will be some \$40 million—half to be spent on the building and half on equipment—and its initial operating budget will be approximately \$20 million per year. All funding needs will be met on a 60:40 ratio by the government and industrial research contracts, respectively.

Three divisions. Structurally, IMEC will be divided into three units devoted to advanced semiconductor processing (ASP), materials packaging, and VLSI systems design methodologies. Priorities in the ASP area will be the development of CMOS technologies, first at 1.25-μm and later submicrometer geometries. For the smaller geometries, the laboratory will use direct wafer electron-beam writing and ultraviolet and X-ray exposure. The other principal ASP activity will center on insulator and conductive layers for VLSI processing.

Researchers in the materials and packaging group will concentrate on advanced semiconductor techniques such as silicon-on-insulator, ultra high-density and radiation-hard CMOS, and III/V materials. A 3-in. gallium arsenide wafer pilot line will be used to develop large-scale field-effect-transistor ICs.

Other activities will include interconnection techniques for hybrid microelectronic circuits in thick-film technologies, fabrication and packaging of sensors, and electrical testing. The design methodologies staff will be involved in design management, geometric design, and architectural and algorithmic strategies.

IMEC's facilities will be available to the Flemish universities by audio-visual links for "teleclassing" as well as by data links to share computer design tools. It will operate a liaison program with Belgian industry and parallel laboratories in other European countries. **–Robert T. Gallagher**

LASERS

Tunable far-infrared laser lights up researchers' eyes

Los Angeles—For research scientists working at the fundamental levels in physics and chemistry, excitement is building over a new laser that can be tuned to operate throughout the far-infrared region of the light spectrum. This tunable laser—a free-electron type, rather than gas or solid-state—promises to open up research avenues hitherto closed for lack of a signal source in the far-IR region.

However, it is not a tool that can be quickly installed in a laboratory. The reason is the instrument requires a 23-ft-high tower to house an electrostatic accelerator needed to produce the electron beam for lasing.

Developed by physicists at the University of California at Santa Barbara during a five-year, \$5.5 million program, the new laser, with its tunable capability, is sparking widespread interest, according to scientists there. The laser makes it possible to study the properties of materials at the molecular or atomic level, where physical and chemical systems can respond to radiation at highly specific wavelengths, they say.

By tuning, or controlling, light wavelengths with the new laser, researchers can pinpoint precisely where such responses occur, which is the previously unavailable key to understanding a wide range of physical, chemical, and biological behavior. By contrast, there are some high-powered conventional lasers that produce far-IR signals, but do so only at fixed frequencies.

Key innovations. The Santa Barbara laser is largely the brainchild of physicist Luis R. Elias, who directed the project. In the course of its development, he came up with several innovations that allowed increased efficiencies and reduced costs compared with other free-electron lasers (FEL) that exist elsewhere.

Unlike conventional lasers, which employ a gas or solid material, an FEL depends on unattached electrons propelled at nearly the speed of light for stimulating the release of light energy. In an FEL, a beam of electrons is produced by an accelerator, then travels back and forth through a periodic magnetic field,

Tower for power. The University of California's laser needs a 23-ft tower for its electrostatic accelerator. The laser is the result of a five-year project at the Santa Barbara campus.

until finally it is extracted as a focused laser beam.

What has limited FELs since the first one was produced in 1977 has been the need for a massive particle accelerator to get the electrons up to speed. These are prohibitively expensive and exist at only the most extensive research facilities. UCSB's Elias instead uses an electrostatic accelerator, implemented through a Van de Graaff generator, that can build up voltages in the range of 3 million to 6 million eV.

Recirculation. Besides being relatively inexpensive and of manageable size, the UCSB laser loses only the amount of energy needed for the lasing action. The electron beam is thus recirculated, an effect that itself acts to stabilize electrical conditions in the laser, an important requirement for producing and controlling long IR waves.

To date, the UCSB laser has operated at the 400-μm frequency and eventually will have a broader range, reseachers say. The school's intention is to have a facility for scientists from other places to conduct basic research.

As for the impact of the tunable instrument, the view of laser inventor Theodore H. Maiman is probably representative. "It should provide a fantastic research tool for an unexplored and unattainable part of the spectrum, as a convenient, tunable signal source," he notes. Now a Los Angeles consultant and entrepreneur, Maiman demonstrated the first laser in 1960, when he was working at Hughes Aircraft Co.'s research laboratories. **–Larry Waller**

PC BOARDS

Coaxial cable's layout inspires bus structure that promises to handle noisy industrial ambiance

Bad Friedrichshall, West Germany— Designers of printed-circuit boards for computers and other high-speed electronics equipment will soon have a new bus structure to work with, one that brings to them the same advantages that the ubiquitous coaxial cable brings to communications engineers. Realized in pc-board technology, the coaxial-bus structure from System-Kontakt GmbH, a small pc-board and back-panel producer, is now being put to the test and optimized for the market.

A new breed of bus system is indeed needed. With ever-increasing data-processing speeds, the demands imposed on the signal-transmission media are drastically changing. Even if no severe transmission problems occur at clock frequencies of up to about five megahertz, higher frequencies demand that such parameters as characteristic impedance and such phenomena as reflections on the signal line and cross-coupling between the lines be considered in laying out signal lines on pc boards.

Coaxial buses can eliminate some problems caused by noisy environments, where computer boards are used in control systems for, say, welding apparatus, spark erosion equipment, and industrial robots. This subjects their signal buses to heavy electromagnetic interference that could render machine control ineffective under severe conditions.

In fact, it was an industrial equipment producer, the AEG-Telefunken subsidiary AEG-Elotherm, with these kinds of control problems that approached the Bad Friedrichshall firm to help solve them. System-Kontakt then implemented the pc-coaxial-bus idea that it had conceived as part of a search for a bus structure optimized to handle very high transmission rates and still be suitable for noisy environments.

Demanding manufacture. The basics of the pc coaxial bus are straightforward, but realizing them in hardware puts stringent demands on the manufacturing processes, explains Rolf Eberbach, technical director at System-Kontakt. With Franz Leitl, head of the firm, he invented the new bus.

In the multilayer panel (see fig-

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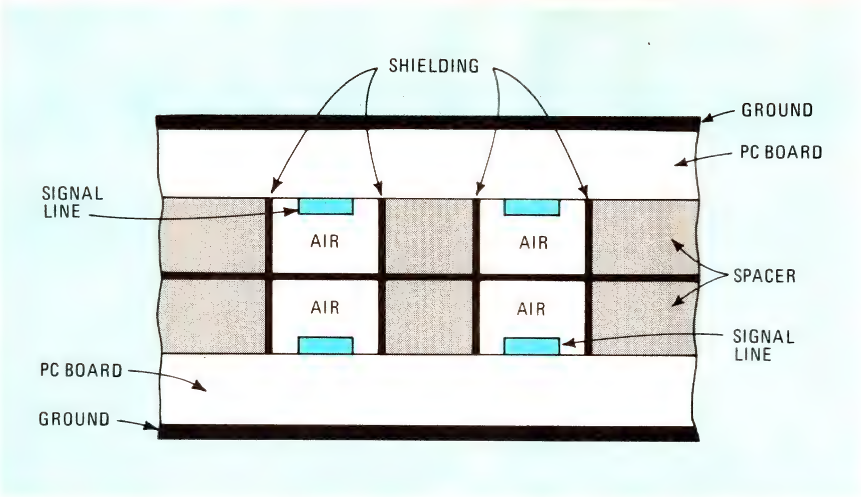

Give it air. In the System-Kontakt pc board, spacers around each signal line create air gaps that serve as a dielectric—much like the inner-conductor insulation in a coaxial cable.

ure), spacers between two pc boards, with signal lines, create a small air space around each signal line. This air dielectric significantly improves performance, as does lining the walls of the air enclosure with metal. Thus, much like the inner conductor in a conventional coaxial cable, the signal line in System-Kontakt's bus structure is located within a dielectric—in this case, air.

"The printed coax bus that is produced that way fulfills virtually all requirements that an ordinary coax line does," Eberbach says. The spacers and the metal lining prevent cross-coupling between adjacent signal lines. Furthermore, a large copper foil, at ground or supply potential and sandwiched between the two arrangements of pc board and spacer, makes for a large capacitance. That condition, in turn, raises the dielectric constant needed in a coaxial-bus structure.

The required high characteristic impedance is achieved by keeping the signal lines as narrow as possible and the distance between the ground layers and the supply-voltage layer as wide as possible. Also, the air space should be large. In fulfilling these and other requirements, compromises must be made between the ideal dimensions and those allowed by the application, Eberbach notes.

Shielding against external electromagnetic fields is provided by the nature of the bus structure itself—that is, because the signal lines are surrounded by a dielectric and then by the spacer and pc-board material. By utilizing proper line terminations, achieved with pull-up resistors or voltage dividers, the billiard effect—where signals on the bus and those between the driver circuitry and the signal receivers run back and forth with little attenuation—can be eliminated.

Current work at System-Kontakt is focused on producing coaxial-bus systems for different applications and optimizing various designs with a view toward achieving realistic price levels, Eberbach says. Some bus systems are already in trial use with specific customers. **–John Gosch**

IC TESTING

Test structures speed chip repair

Boston—If two companies in the laser-repair equipment business have their way, there will soon be destruction in the streets. The streets they're referring to are the channels between dice on wafers of 256-K memories with redundancy. The destruction will be of verification structures, which will make it unnecessary to retest repaired chips.

The verification structures are part of a two-pronged attack on the problem of underutilization of the costly test and repair equipment needed to produce redundant integrated circuits. The other aim is to separate the test and repair functions.

On-line or integrated test and repair systems are efficient early in the development of new memory chips when engineers need a tight feedback loop for experimentation. But after chips have been debugged and manufacturing volume increases, keeping the expensive test and repair equipment operating efficiently becomes difficult. Because on-line systems make test and repair dependent on each other, lasers must wait for testers to pass along the few parts that are repairable. Meanwhile, the testers get bogged down waiting to retest parts that have been repaired.

Verification. Teradyne Inc., of Boston, and Electro Scientific Industries, Portland, Ore., are proposing that chip makers place verification structures in the streets as part of a correlation system to eliminate the need for retesting. By monitoring the pattern of broken links in these structures, a level of confidence can be achieved that repairs have been successfully completed.

But this eases only part of the utilization problem. Laser run time can drop to 10% to 15% in integrated test and repair systems when the yield is reasonable, according to Donald Stewart, marketing manager for Teradyne. Later this month, the company will announce a proprietary add-on for its production systems for redundant 256-K memories. The add-on, called TeraSTAR (for Teradyne Simultaneous Test And Repair), lets multiple testers feed a single repair station. It will cost about $50,000 and is expected to be available in the second quarter of 1985.

TeraSTAR is a software development that allows wafers, test information, and repair information to move independently while a host computer maintains data for each wafer. The ability to identify wafers is required, so Teradyne is also offering optional alphanumeric and bar-code readers as part of the package at additional cost.

Because TeraSTAR allows several testers to plug into a system that feeds a single repair station, the flow of repairables to the lasers will be increased, improving utilization at that end, Stewart says. Down time for testers will be cut because verification structures will free them from retesting the chips after repairs.

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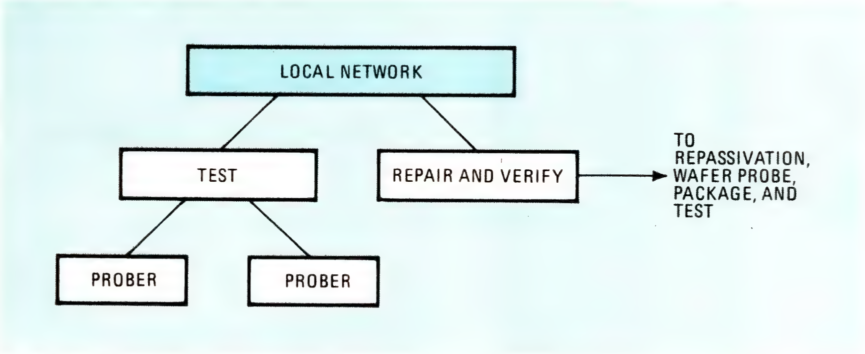
making some changes. Early next year, it expects to provides its lasers with interfaces to host computers. "A lot of people have factory information systems," says Tom Salicos, ESI product manager. "The job for lasers is to access that information and make repairs." For those without existing information systems, ESI will offer its own host computer.

No second probing. The company will also push for verification structures as a means of ensuring repairs, says Solicos. Neither firm anticipates resistance from IC manufacturers over adding the verification structures, because the additions will be placed in the spaces between the dice. Chip makers may in fact like the idea, ESI and Teradyne agree, because it would eliminate the second probing of ICs that is required by a full retest and possibly cut their equipment investment overhead.

Stewart emphasizes that verification structures have not yet been tested in the field. "We have a high degree of confidence, but you never know until you try," he says, adding that the procedure should soon be at beta sites.

If the verification structures do not work, Teradyne will propose putting a tester at the repair station. Stewart says this would still save time because only repaired chips would be retested. If the verification structures do work, he estimates equipment costs will be halved; even if a second tester is needed, chip makers could cut investment by one third, he says. **-Craig D. Rose**



Saving through separation. Linking the tester and the repair laser for redundant 256-K RAM wafers through a local network allows the two to work independently, speeding up the cycle.

SEMICUSTOM ICs

Design interface handles up to 100,000 gates

Caswell, Northants., England—The first of a new wave of jumbo smart-cell libraries promises to speed semicustom microcircuit design and reduce design errors. Unlike the cells used in traditional cell-based design methodologies, these big, new structures—among them memories, programmable logic and gate arrays, and arithmetic-logic units—will be automatically customized to a designer's specification.

One of the first of these libraries surfaced in Edinburgh last month at the 10th European Solid-State Circuits Conference. Aptly called Megacell, it has been developed at the Plessey Co. plc's Allen Clark Research Centre, in close collaboration with ICL plc's West Gorton design group. "We have been working with Plessey for two years to develop this kind of design interface," says Gordon Adshead, who heads ICL's computer-aided design effort.

Programmability or paramaterization, as it is called, uses clever software to compile custom cells with no manual intervention and is, in effect, a miniature silicon compiler. For each programmable function, a set of primitive cells is hand-crafted and stored in a library together with the assembly rules for constructing the overall function, be it a random-access memory or an ALU. This assembly software automatically generates any new cells and adds them to the user's library.

Any size. For example, a user can order any size RAM up to 16-K or read-only memory up to 64-K, set the word width, and make the cell square or long and thin to fit the space. Circuit designers can specify the number of cells in a gate array as well as the number of cells in a row and the number of wiring channels between rows. They can also call up and specify the word lengths of programmable logic arrays, ALUs, adders, comparators, and so on.

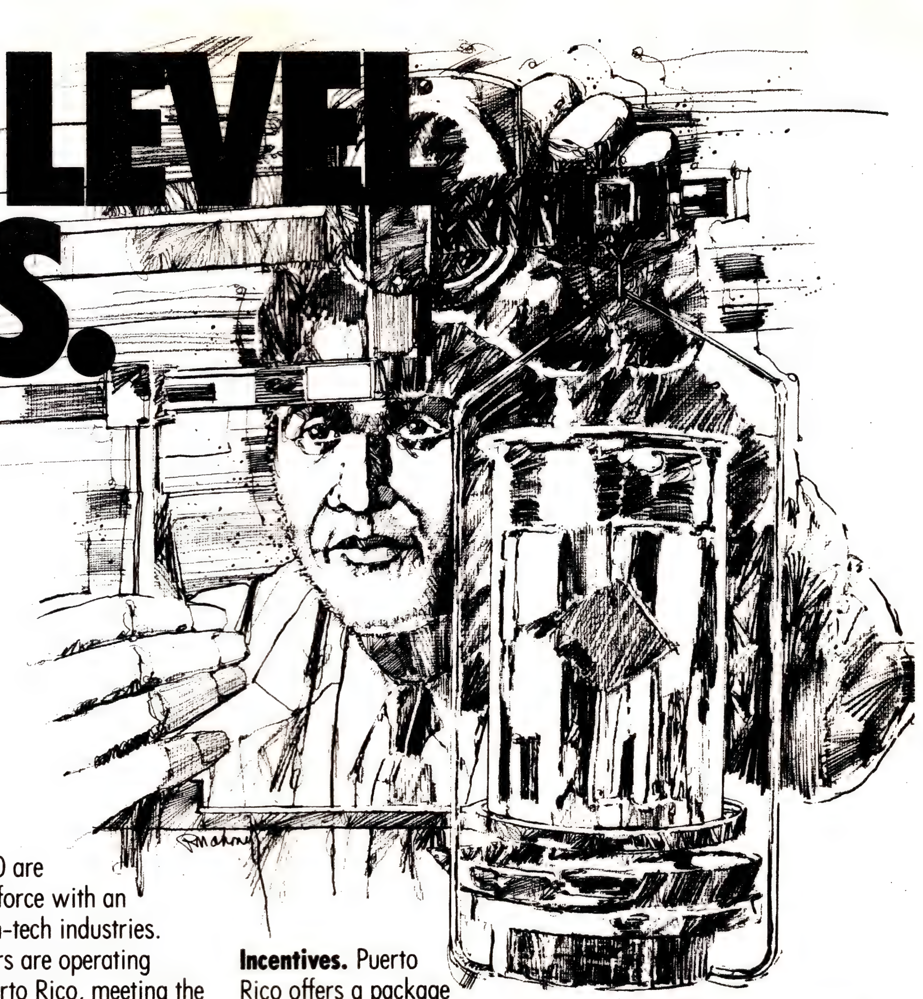
The designer would only need to piece a few of these structures together, with perhaps a few simple gate cells of fixed structure, to assemble a complete central processing unit or multiplier circuit. This contrasts with a traditional cell library—having an average of 10 gates per cell—where a typical very large-scale integrated-circuit design would be built from several thousand cells.

Megacell can handle semicustom designs of up to 100,000 gates, says Barry J. Prior, who heads the Megacell effort. It maps onto the company's 2.5-μm complementary-MOS double-layer-metal process, now in pilot production here and shortly to be transferred to a $63 million plant under construction at Plympton, Plymouth. Also, the company will announce a U.S. second source soon. Even so, it is limiting orders for the moment to a few select customers, according to John Brothers, Megacell marketing manager at Plessey Semiconductors, Swindon.

Plessey's CMOS process can put up to 30,000 gates on a silicon chip, with gate delays of 1 to 2 nanoseconds and clock speeds from 40 MHz to 15 MHz. Moves are also afoot, with funds from Britain's fifth-generation program, to produce a process-independent cell library.

Although ICL's data processing activities have strongly influenced the Megacell concept (the firm is currently using it to lay out a 32-bit microprocessor), Megacell is a general-purpose design tool. It is already being used in house to design a 10-MHz, 16-bit pipelined multiplier, a

HIGH-LEVEL SKILLS.



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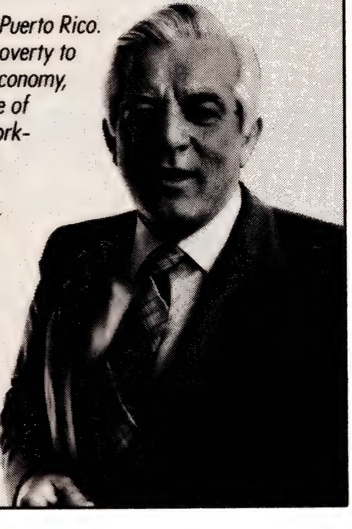

Carlos Romero Barcelo

Carlos Romero-Barcelo,
Governor of Puerto Rico

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*U.S. Internal Revenue Code Sections 936 and 243(b)(1)(C). Section 936 companies are allowed to bring current profits home (as determined under TEFRA, 1982) without U.S. taxes. However, a Puerto Rico tollgate tax on distribution dividends of 10% or less, depending on the conditions under which funds are repatriated, will be levied. © 1984 Puerto Rico Economic Development Administration.

THE INDUSTRIAL EVOLUTION OF PUERTO RICO. U.S.A.

THE AMERICAN SUCCESS STORY IN THE CARIBBEAN.

Circle 27 on reader service card

Storing analog functions

Along with its Megacell digital cell library for semicustom design, The Plessey Co. plc's Allen Clark Research Center, Caswell, Northants., has also developed a fixed cell library of analog functions. Like Megacell, these analog functions are implemented in the company's 2.5-μm CMOS technology, so that digital- and analog-interface functions can all be combined on a single chip. The cell library includes a variety of operational amplifiers with various power dissipations, drive and speed capabilities, comparators, switches, and an 8-bit digital-to-analog converter. These basic functions make it possible to combine digital functions with switched-capacitor filters, DAC and analog-to-digital conversion systems, amplifiers, interface circuitry, and many other circuits to achieve total systems integration.

These cells operate up to video frequencies and, in switched capacitor configurations, will handle signal frequencies up to tens of kilohertz. Telecommunications is a prime application for this technology, says the company. Two levels of metalization and polysilicon oxide diffusion-type capacitors are available. The technique has been evaluated by the design and layout of a dual-channel, switched-capacitor, low-pass filter. –**K.S.**

fast Fourier transform butterfly, a complex floating-point arithmetic chip set, and an edge detector for real-time imaging applications. Furthermore, Megacell's digital library can be complemented by a variety of analog cell functions (see "Storing analog functions," above).

The initial customer interface with Megacell is a high-level hardware-description language. With this tool, a designer can specify and simulate his design and refine it, in increasing detail, before it is eventually mapped onto the Megacell library. To facilitate this transfer, functional descriptions of the cells are coded in the hardware-description language and kept in the library.

The final stage is similar to present cell-based systems: cells are placed interactively on a graphics terminal, and their interconnections routed in. Meanwhile, the layout software compares the growing layout with the original software descriptions and flags errors such as overlapping cells or shorted and incorrectly routed tracks.

In effect, Megacell brings cell-based and silicon-compiled methodologies onto a converging path. True, a silicon compiler takes the designer out of the layout loop, generating a mask set from his high-level functional description. "But, full chip compilers do not produce very compact layouts, and they tend to be architecture-specific," cautions Prior. "Megacell will suit a very large range of applications. And chips designed using the system are comparable in both speed and area with full custom designs." –**Kevin Smith**

SUMMARY OF PARACELLS

Function	Programmable word size	Maximum cell size	Cell limit
RAM	8 to 64 bits	32 to 2,048 words	16-K maximum
ROM	4 to 32 bits	64 to 2,048 words	64-K maximum
Programmable logic array	2 to 32 instructions/s	2 to 32 operations/s	8 to 128 terms
Arithmetic logic unit	4 to 32 bits	16 functions	
Adder	4 to 32 bits		
Comparator	4 to 32 bits		
Content addressable memory	4 to 24 bits	4 to 16 words	
Register file	4 to 32 bits	4 to 16 words	
Autorouted gate array	up to 10,000 gates		

SOURCE: PLESSEY CO. PLC

SEMICONDUCTORS

SIA foresees record growth

Santa Clara, Calif.—Despite the current slump in book-to-bill ratios, the Semiconductor Industry Association is forecasting the greatest period of growth in industry history for 1984 and beyond. Worldwide sales this year will amount to \$26.3 billion, a 48% increase over 1983, according to SIA figures released last week. Strong growth patterns throughout the next few years will bring annual sales to the \$43 billion level by 1987, more than double those of 1983, the data indicate.

"We are on our way to the most explosive year in the history of our industry," said Irwin Federman, president of Monolithic Memories Inc. of Santa Clara. Federman delivered the forecast at the annual SIA dinner here.

This year, for the first time, the SIA, based in San Jose, Calif., included estimates from Japanese manufacturers in its forecast. In addition, Texas Instruments Inc., Dallas, which has declined in the past to provide estimates, thus forcing the SIA to make its own guesses, joined in the SIA effort this year. The SIA totals for 1983 were raised by about one third to account for the Japanese participation.

There were few surprises in the

"WHEN YOU CAN MEASURE WHAT YOU ARE SPEAKING ABOUT, AND EXPRESS IT IN NUMBERS, YOU KNOW SOMETHING ABOUT IT . . . AND YOU HAVE, IN YOUR THOUGHTS, ADVANCED TO THE STAGE OF SCIENCE."

William Thomson, Lord Kelvin
British Mathematician and Physicist, 1894

Photo Courtesy of National Museums, Paris.

The Moneychanger and His Wife–
Quentin Metsys, 1514.
A fine example of Flemish genre painting in which the detailed examination of ordinary objects is a popular theme.

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Circle 29 on reader service card

SIA figures. The industry's fastest-growing component group was, predictably, complementary-MOS products, which are expected to grow 71%, to $3.2 billion this year. CMOS will continue to experience a 35% compound annual growth rate through 1987, when it will reach $8.2 billion, the SIA said. But even discrete devices are on a roll, and will grow 26% to $5.6 billion this year, and to $7 billion by 1987, according to the SIA figures.

Discretes largest. The actual breakdown showed discretes are still the largest single category, at 21.1% of total semiconductor sales. MOS memory was next at 19.2%, followed by bipolar ICs, 18.5%, analog ICs, 16.1%, MOS logic at 13.1%, and CMOS at 12.1%. By 1987, the SIA said, CMOS will be second only to MOS memory, with market shares of 19.2% and 20.2%, respectively.

The Japanese market, Federman noted, is growing faster than that of the U.S., and the "ROW" (rest of the world) categories. Because Japanese suppliers account for more than 98% of sales in Japan, their share of the world market will continue to grow at the expense of U.S. firms, he said. "There is no reason we should have a dominant share of the market in Europe and account for only 8% in Japan," he added.

The SIA forecasts were predicated on a 2%-to-3% growth in real gross national product in the U.S., with no major changes in interest rates. The association looks for a flattening of economic growth in the second half of 1985, but no major recession.

Federman conceded that past SIA forecasts have not been particularly accurate in their near-term outlooks. "There are lurking variables," he said. "But beyond three years out, the actual sales results have always been higher than the SIA forecasts."

While the SIA was willing to predict semiconductor sales through 1987, its chart of the book-to-bill ratio stopped at August 1984. "You can't predict order rates—they are a matter of psychology," Federman said. However, current industry backlogs are high enough to tolerate a continuation of the August 1:1 book-to-bill ratio for at least three months, the executive said. September orders continued to be soft, Federman said. **–Clifford Barney**

EQUIPMENT SERVICE

Analysts differ on how much gold can be panned from service calls

New York—With sales of all types of electronic products expected to continue escalating steadily throughout the decade and with the installed base of various electronic equipment aging, one thing is certain: revenues from servicing and repairing that gear seem destined to continue to grow at a healthy clip. That's the enthusiastic opinion of Big Eight accounting firm Arthur Andersen & Co., in New York, which has conducted a study involving 100 service-company executives.

Equipment manufacturers will continue to dominate the service industry, the study reports, although the number of firms servicing third-party products is increasing. As the shape of the industry changes, stiff competition for service contracts is expected along with an increasing need for those seeking them to fine-tune marketing plans.

Though there is agreement among industry analysts on these points of the Arthur Andersen study, just how fast the service industry will grow is up in the air. The Andersen study says it will double by 1990 to become a $46 billion industry, "one of the most attractive growth markets in the U.S. economy."

Others can't imagine such stellar growth. "To blandly predict an eight-fold increase in revenue defies logic," Kenneth G. Bosomworth, president of International Resource Development Inc., Norwalk, Conn., notes, referring to the Arthur Andersen prediction that service revenue just for office-automation products will grow from $1.1 billion to $8 billion by 1990.

Input Inc., a Mountain View, Calif., market research firm, is also less optimistic than Arthur Andersen. When comparing the categories it covers—basically computers and communications products—with Andersen's study, Input's projections are $26 billion for 1989 compared to Andersen's $36.6 billion in 1990. One reason for the lower figures, according to Input vice president Graham Kemp, is that while the number of installed systems is increasing, revenues per contract are decreasing.

Failures wane. Several factors are damping the revenues per system that a firm can reap from service contracts. Products today have fewer moving parts and electronic components. Improved diagnostics and easier servicing are also cutting revenues. The number of equipment failures will drop by 25% to 50% per year for mainframes, minicomputers, and office-automation systems introduced through 1990, according to the Arthur Andersen report. On the other hand, products employing very large-scale integration technology can require more sophisticated servicing,

U.S. ELECTRONICS SERVICE INDUSTRY REVENUE GROWTH BY PRODUCT GROUP
(BILLIONS OF DOLLARS)

Sector	1983	1990
Telecommunications	5.9	13.6
Mainframes	3.9	6.2
Peripherals	0.8	2.0
Industrial electronics	0.3	2.0
Consumer electronics	0.1	1.0
Minicomputers	3.9	7.5
Office automation and microcomputers	1.1	8.0
Medical/health care	0.8	2.2
Office equipment	2.4	4.2
Total	19.2	46.7

SOURCE: ARTHUR ANDERSEN AND CO.

SCIENCE/SCOPE

Troublesome electrical charges that build up on space vehicles will be overcome by an advanced charge-control system being developed by Hughes Aircraft Company for the U.S. Air Force. The Flight Model Discharge System will use a self-contained plasma source to effectively "ground" the spacecraft surface to the surrounding space plasma, eliminating disruptive arcing for charged surfaces. The system will monitor both vehicle potential and space-environmental conditions to detect the onset of spacecraft charging. It will operate a plasma discharge device to neutralize charge buildup. The plasma discharge operates on xenon gas, ignites in one second, and requires only 10 watts of power.

Heat pictures are screening printed circuit boards for such defects as open or short circuits and failed components. The Automatic Infrared Test & Inspection System (AITIS) uses a cooled, 60-element infrared detector to create a high-resolution thermogram. A computer compares a tested board with a master thermogram stored in computer memory. Components that appear too warm or too cool are shown in color-coded temperatures on a video monitor. As a complement to automatic test equipment, AITIS saves time and money. Hughes developed AITIS under its independent research and development programs and contracts with the U.S. Army Missile Command and U.S. Air Force.

A trio of multipurpose communications satellites has been introduced by Hughes to handle standard communications and direct TV broadcasting to homes. All three are drum-shaped and spin-stabilized. One model, designated HS 393, is the domestic communications satellite of the future. It can carry 16 high-power channels or 48 channels at lower powers. A second spacecraft, the HS 394, has a flat, sun-tracking solar array, thereby combining the best features from the existing technologies of spin-stabilized satellites and body-stabilized satellites. The third model, the HS 399, is a small spacecraft with 12 channels. Occupying only one-fourteenth of a space shuttle cargo bay, it could be launched for about one-third the cost of orbiting a standard 24-channel satellite.

An advanced factory management system model, developed by Computer Aided Manufacturing-International and Hughes, will help optimize use of manufacturing resources. The model will address interactions of all work areas within every level of the organization. It will precisely identify department production capacities, queue bottlenecks, and resource flow.

A broadband gallium arsenide field-effect transistor that operates in the 20 GHz frequency range has been introduced by Hughes. The new power transistor chip, designated Model C0311H-2000, is guaranteed to operate in a 50-ohm system over a typically 2-GHz bandwidth. It is designed as a medium power driver with 6.5 dB gain guaranteed at a 100 mW output level.

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HUGHES
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thus resulting in more revenue.

"The decrease for television servicing has offset some other increases, and the home computer is a real bust as a service opportunity," notes Bosomworth. Citing the falling prices of low-end systems, he says, "The era of the throwaway computer has arrived." As for more sophisticated products such as test equipment, he maintains that "it's almost unheard of for a Tektronics oscilloscope to need servicing."

Inconsistent. Projections regarding the available harvest for third-party servicers at the end of the decade are also inconsistent. Andersen says these revenues could reach $9 billion by 1990. Input envisions a $2.5 billion opportunity for third-party servicers in 1989. Robert McKeon, president of ITT Sercom, a service division of ITT Corp., New York, that offers third-party service, sees a $3 billion to $4 billion opportunity for firms like his in 1990.

Nonetheless, the competition is undoubtedly heating up. Since 1982, 72 firms have entered this arena, bringing the total to around 118, according to a survey conducted by the 4,000-member Association of Field Service Managers, which co-sponsored Andersen's study.

A number of major manufacturers are now—or will soon be—offering third-party service, especially on those products networked to their own, according to Andersen. Service contracts may contribute 15% to 30% of total revenues for dozens of high-technology, maturing companies, Andersen maintains, and third-party service needs more attention from top executives.

The Andersen study points out that manufacturers such as Control Data, ITT, and Xerox will service competitive products, possibly to counter potential revenue losses due to competition among products. It expects many others, such as AT&T, Wang, Burroughs, Digital Equipment, and NCR, to offer third-party service on other firms' equipment.

"In many cases, companies have started third-party servicing because their guys don't have enough to do," says Bosomworth. For example, ITT Sercom, a division of ITT Systems Inc., which installs, maintains, repairs, and provides emergency service for both ITT products and those made by third-party firms, is a reorganized version of a division that serviced ITT Courier terminals. According to Sercom president Robert McKeon, the division's workforce was increased by just 2% to handle the extra work.

McKeon expects Sercom's sales to grow sevenfold by 1989, but he too believes opportunities will be more limited than most analysts believe. "I think the industry will mature very fast," he says. **–Steve Haggerty**

SUPERCOMPUTERS

Amdahl shoots for two markets with IBM-compatible supercomputer

Sunnyvale, Calif.—Just one year after Fujitsu Ltd. brought out its IBM-compatible supercomputer series, the Facom VP/100 and VP/200, its U.S. affiliate, Amdahl Corp., says it will market the machines in this country and in Europe.

The machines, which will be the Amdahl 1100 and 1200, are vector processors that will perform at peak rates of 533 million floating point operations per second and 267 megaflops, respectively. Most importantly, they will run existing IBM software, written in Fortran, without modification. U.S.-built supercomputers have proprietary operating systems and are not compatible with IBM equipment.

Amdahl, which is 49% owned by Fujitsu, in Tokyo, has been working on the supercomputer program for the past three years. Last May, it formed a new branch of its Peripheral Products Division—with the deliberately vague name of "Special Purpose Systems"—to market the Japanese machines. (The Peripheral Products Division also markets Fujitsu disk drives and a Fujitsu communications controller.)

Special Purpose Systems director Wayne McIntyre says Amdahl has previewed plans to sell the supercomputers to about 75 customers around the world. Amdahl will get its own VP/200 in November, and it is promising first shipments in the second quarter of next year.

Though the firm is mum on actual sales forecasts, it hints that six sales in the first year would not be unreasonable to expect. Basic price is $9.2 million for the 1100 hardware and $13.7 million for the 1200. Software rents for $16,000 a month; maintenance is $35,900 a month for the smaller machine and $51,000 a month for the larger one.

The ideal prospective buyer is a customer with a large commercial, scientific, or governmental IBM software base, McIntyre says. The least likely prospect would currently be using systems made by Cray Research Inc. and Control Data Corp., both of Minneapolis, because the Japanese computers have been deliberately designed to be compatible with IBM System/370 architecture.

Software for the machine includes an optimizing compiler that takes IBM Fortran as a source and produces a vectorized code that will run 11% faster than the original. In addition, system software includes 83 vector instructions that may be used in writing new code for the machines. Amdahl has tailored existing scientific and engineering applications to take advantage of the vector processor. All IBM peripherals are also supported.

Although the processors are Japanese-designed and made, they use the multiple-chip-carrier and air-cooling technologies developed at Amdahl for its 580 computer family.

Fujitsu now becomes the first Japanese firm to market a supercomputer in the U.S. Hitachi Ltd., Tokyo, also makes a supercomputer, the 800-megaflops S-810/20, and has a U.S. marketing link—National Advanced Systems, Sunnyvale, Calif. That firm, a division of National Semiconductor Corp., already markets a 25-megaflops Hitachi array processor; a spokesman declined to say whether it would also offer the supercomputer. **—Clifford Barney**

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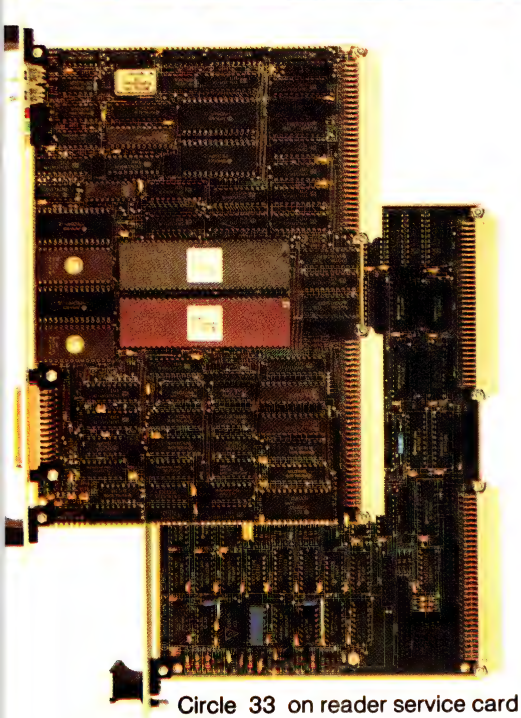
Circle 33 on reader service card

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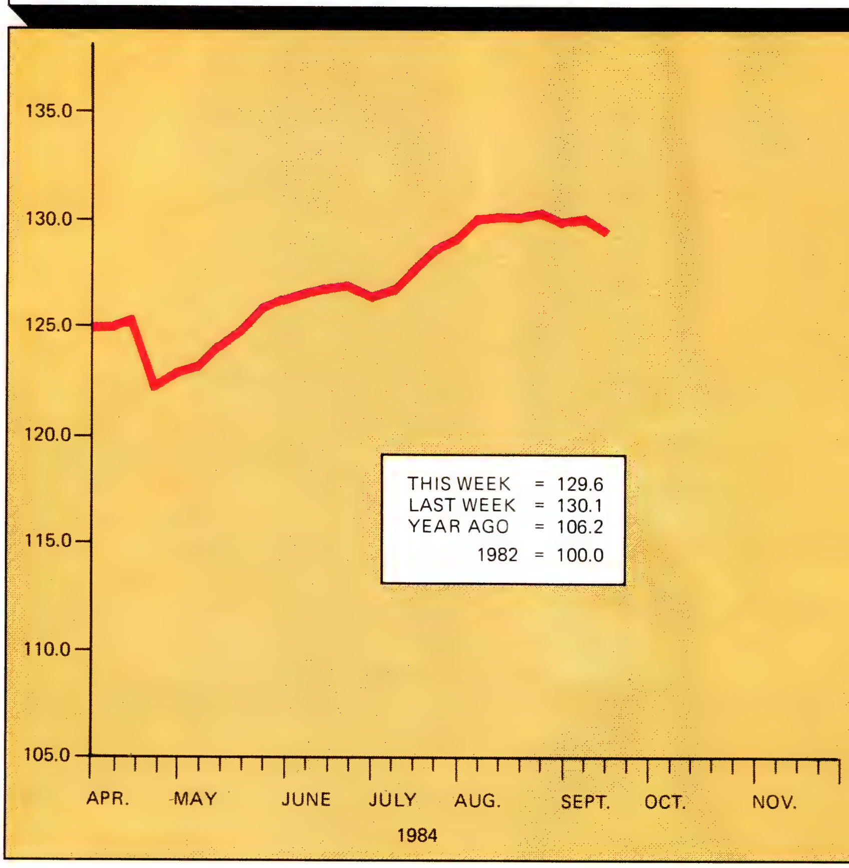

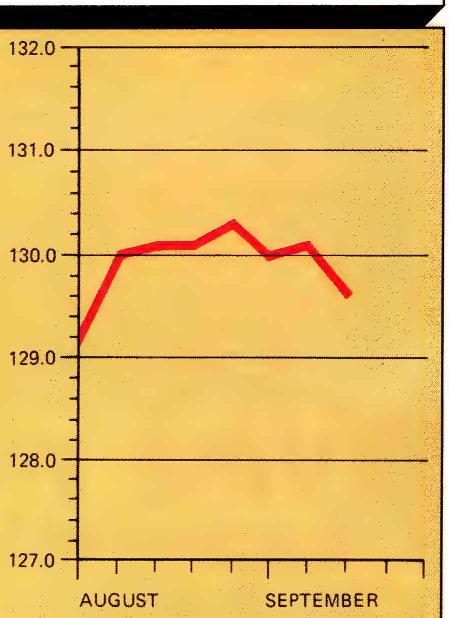

The *ElectronicsWeek* Index, a seasonally adjusted measure of the U.S. electronics industry's health, is a weighted average of various indicators. Different indicators will appear below from week to week.

U.S. ELECTRONICS IMPORTS AND EXPORTS (MILLIONS OF DOLLARS)

	IMPORTS			EXPORTS		
	July 1984	June 1984	July 1983	July 1984	June 1984	July 1983
Accounting, computing, and data-processing machines	375.109	296.628	195.194	589.682	646.975	441.637
Calculators	70.522	45.740	34.808	7.124	8.654	6.822
Parts for data-processing machines and office calculators	451.663	328.999	245.484	565.919	555.610	448.329
Telecommunications, sound-recording, and sound-reproducing equipment	1,696.795	1,212.517	945.404	373.902	335.218	357.168
Electronic or electric instruments	149.542	110.383	88.078	540.205	499.349	498.889
Printed-circuit boards	30.499	19.823	11.220	22.511	22.854	14.602
Integrated circuits, diodes and other semiconductors, tubes, piezoelectric crystals, parts	915.897	633.579	519.095	522.689	529.263	390.232
Fixed and variable resistors	38.100	26.910	20.573	15.316	17.039	12.582

A drastic widening in the U.S. trade gap for electronics equipment caused a drop in the *ElectronicsWeek* Index for the latest week. Imports of various electronics equipment soared by 39%, with strong improvement in every product category. At the same time, exports of U.S.-made electronics goods stagnated, growing only 0.8%. Most of the weakness in exports was concentrated in the components area: exports of printed circuit boards, resistors, and semiconductors all fell.

The blame for this dismal performance in overseas markets falls upon the ever-strengthening U.S. dollar, which during most of September continued to set records against most European currencies.

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AT ITT, EXCITEMENT AHEAD FOR MARKETING MAVEN JAN LOEBER

On the spot. Jan Loeber thinks that one of ITT's sales advantages is its European identity.

Brussels

Jan Loeber is unlikely to get bored anytime soon. With his recent assignment as vice president and market and product management director for telecommunications and electronics at ITT Europe Inc., not only is the German-born American adjusting to a new foreign living environment in Brussels, Belgium, but he is responsible for marketing a line of products ranging from the company's System 12 digital telephone switch and data processing systems to television sets.

If the spread of products isn't dizzying enough, there are two further complications for the marketer. First there is the heterogeneity of the European market. Then there are the political considerations that inevitably crop up in any effort to sell products that are as strategically important as switches to the governments that control their respective telecommunications networks.

A U.S.-based multinational should be at a clear disadvantage competing in this market against native European switch producers, but Loeber thinks that ITT has created something of a special situation for itself with a network of subsidiaries that look very much like independent European corporations. "Our European companies have local production and research facilities and for the most part are managed by local people," he points out. System 12 is currently being produced by ITT subsidiaries in Belgium, West Germany, Spain, and Italy.

Loeber, 40, came to ITT after heading AT&T Co.'s effort in the marketing and product engineering of private automatic branch exchanges and processors. He began his career with IBM Corp. after taking a bachelor's degree in physics at Michigan Technological University and an MBA at George Washington University, in Washington, D.C.

ITT has already done admirably well selling System 12 in Europe, and Loeber is one of a minority who is optimistic that the usually protectionist European telecommunications market will gradually open even more as the sale of advanced digital switches continues.

"Maybe it's because I come from the American system, but I think market forces are going to be the catalyst that open the European telecom market. We are moving quickly toward ISDN [integrated services digital network] environments. When a country's industry begins to suffer and become less competitive because there is no infrastructure that allows it to move data efficiently to the place where it has to be, you're going to see that country turning to the people who can supply the equipment that can provide those essential services—regardless of nationality." –**Robert T. Gallagher**

From ITT spinoff to billion-dollar status is Luckman's game plan for STC Components

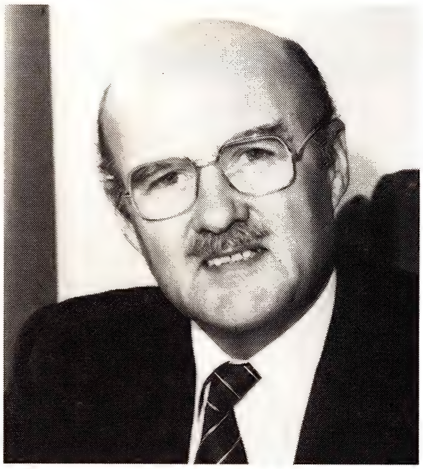
Harlow, England

Ronny Luckman is back in the saddle after over a year away from the electronic components business that he knows so well. Luckman, a 55-year-old sales and marketing veteran of ITT Corp.'s European Components Group, had taken an early retirement to run a small printing business in Bath, Somerset.

He returned, taking up a contract to serve as sales and marketing manager offered by his old boss Ken Walton, now managing director of STC Components Ltd. He will help the company, with almost $325 million in sales this year, as it undergoes the most fundamental change in its history. The firm was formed by the partial divestiture of ITT's European subsidiaries.

Until 1981, all the divisions making up STC Components Ltd. were tightly integrated into ITT's European Components Group. But when ITT reduced its holding in Standard Telephones & Cables plc to 35%, STC—and with it, STC's components subsidiary—became independent operations.

Luckman's role in this new setup is to restructure STC's sales and marketing operation to fit its new independent role. Having spent most of his working life with the group, he could not have been better qualified



Back in harness. Coming out of retirement, Ronny Luckman is directing STC Components sales and marketing.

for the task. Under his pioneering direction, STC developed one of the largest distributor operations in the UK. He also knows the five component divisions—electron devices, semiconductors, microdevices, capacitors, and power devices—inside out. Its activities span an extraordinary range—from hybrid manufacture, now a booming business with sales of line cards for Britain's X exchange—to fiber-optic components, and from power supplies to reed relays and traveling-wave tubes.

Luckman's talents and knowledge will be exploited to the fullest in creating an effective overseas sales operation from scratch, now that the ITT and STC operations have been disentangled from each other.

One of Luckman's priorities was to establish a separate marketing operation for the memory and custom-circuit plant in Footscray, Kent—bought from ITT Intermetall GmbH, Freiburg, West Germany, and now in operation as an independent unit. To head it, he appointed Richard Phipps, formerly with Texas Instruments Ltd.

STC also purchased the tantalum capacitor production unit from Standard Elektrik Lorenz AG, Stuttgart, West Germany. With that unit added to another recent acquisition, Union Carbide's UK tantalum capacitor production unit, and to STC's own operation, STC can count on a strong 30% share of the European market and 60% of the UK market.

One new activity is gallium arsenide. At its Standard Telecommunications Laboratories, Harlow, STC has a strong expertise in digital GaAs technology, and it is now investing heavily in production capacity to exploit this expertise.

The firm has also set its sights on the consumer sector by offering better service than Far East suppliers. This is a marked change from its position a while back.

"In the last six years we have quadrupled our turnover to $325 million," says Luckman. "And in the next six years we plan to do the same thing again." Planning the creation of a $1-billion turnover business is not bad for a once-retired executive. **–Kevin Smith**

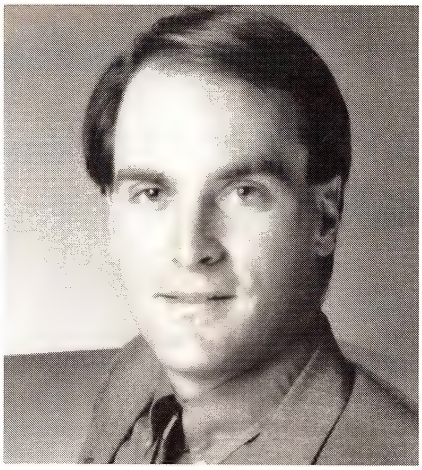
For Jenkins, it's computer business, rather than technology, that matters

Berkeley, Calif.

Not all computer companies are founded by technological mavericks. "I never had an interest in computers, and still don't," says Kevin Jenkins, the 30-year-old president of Hercules Computer Technology. "For me, they're solely a business proposition." It's a proposition he enjoys. "I like this business because it's so unpredictable and there's a lot of money in it."

Thanks to all the money being spent by consumers in the personal computer arena, his company, a manufacturer of graphics add-on boards for the IBM Personal Computer, has grown from a garage operation in 1982 to a concern expecting revenues in excess of $5 million monthly by year's end. The company's first product, the Hercules Graphics Card, claims a 60% market share.

The University of California at Berkeley graduate and former graphics arts magazine publisher went into peripherals as a way to make a better living. After reading business publications, he chose to try his hand at computer technology, and through friends he met his partner, Van Suwannukul, designer of the company's graphics card. From the company's second month, it has operated at a profit.



Rule breaker. Kevin Jenkins engineered a successful start-up without venture capital, executives, or consultants.

Jenkins' success has come, in part, from his ability to run Hercules with the same lean and mean spirit it had in the beginning. He broke the rules by forsaking the security of venture capitalist's funds and the advice of management consultants. What the company has relied on is a small (about 40) but highly productive staff.

The company's productivity enabled it to succeed where others failed. His approach was to let the company respond to the pull of the market rather than spend time and money try to push the market.

Though the company has been riding the crest of success brought on by the IBM PC, Jenkins labels as unfair any suggestion that his company is just opportunistic. "We're no different from anybody else in the computer business," he says. Like many add-on manufacturers, he thinks his company's product helped IBM by enabling that company to bring out incomplete products.

As Hercules enters a new phase with the shipping last month of its second major product—a color graphics card for the IBM PC—it remains to be seen whether Jenkins can maintain the start-up momentum. He is not worried about being shut out by IBM, maintaining that a manufacturer can be successful by filling niches. His advice to other entrepreneurs is, "Don't let anyone bully you into thinking there is anything wrong with being a one-product company." **–Clifford Barney**

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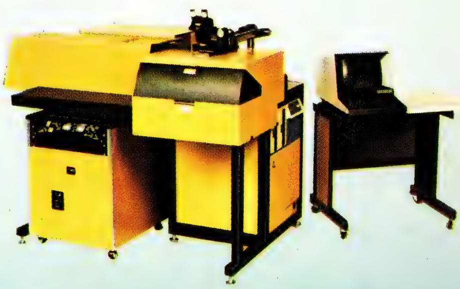

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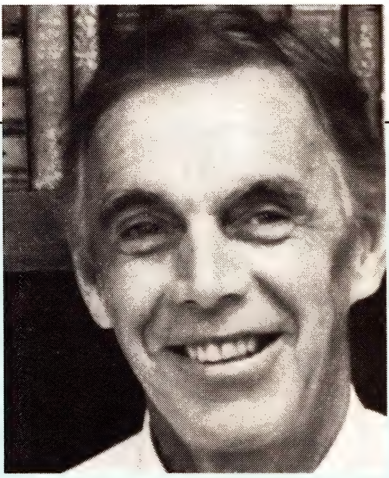
ITS TRANSFORMATION OVER, GOULD SEEKS TO FILL PROMISE

"Gould, in 1984, will complete one of the most substantial restructurings in corporate history..."



Chairman William T. Ylvisaker

Rolling Meadows, Ill.

Although the Gould Inc. of years past was perhaps not as badly off as the frog that was turned back into a prince in Hans Christian Andersen's fairy tale, executives are hoping a just-ended corporate transformation will be no less dramatic.

The change engineered by Gould chairman William T. Ylvisaker starting in 1980 is now complete. With the sale of its lead-acid battery operations in April, Gould disposed of its last nonelectronics business. The firm, located in this Chicago suburb, will now face the future with 20 separate divisions assembled through acquisitions and internal development, all aimed squarely at emerging high-growth electronics markets.

"I don't think we'll be constrained by a lack of opportunity," says new president and chief operating officer James F. McDonald. "If you look at computer systems, factory automation, semiconductors, materials, and defense, I think you'll find that most of those businesses are growing somewhere around 20% to 25% per year. Our challenge now is to make sure that we grow at a rate equal to or greater than the industry."

The burden of that challenge will fall heavily on McDonald, brought in last July to head day-to-day operations at the conglomerate. The 21-year IBM Corp. veteran is being counted on to provide big-time high technology management skills.

"McDonald comes in with a good understanding of how management should work at a major technology company," observes Edward C. White Jr., an industry watcher at E.F. Hutton & Co. Inc. in New York. "His job is an organizational job. It's a marketing job, and it's a strategic positioning job. Those are the key strengths he brings in."

Indeed, McDonald's background seems to suit him well for the position. At IBM, he was general manager of the manufacturing systems products business unit, which he helped develop from scratch in Boca Raton, Fla. His responsibilities there included the development, manufacturing, and marketing of industrial robots, sensors, and controllers to drive flexible manufacturing cells, as well as overseeing IBM's internally used automation products. Prior to that, he held a plethora of assignments, both at the IBM corporate and divisional level, in product and financial management, strategic planning, manufacturing, and marketing.

As McDonald says, "I was fortunate enough to have a number of assignments that allowed me to get a visibility of the business from a lot of different views. I grew up with divisions that started relatively small and grew into multibillion-dollar businesses," an experience he thinks will prove helpful in his new job.

Revamped operations. The new Gould is organized into four business sections: minicomputers and factory automation, electronic components and materials, defense systems, and test and measurement and medical instrumentation. Gould's strengths include a leading position in programmable controllers and in high-performance 32-bit minicomputers. Its Computer Systems Division (previously Systems Engineering Laboratories Inc.) supplies between 55% and 60% of all computers used to drive computer-based simulators.

Likewise, Gould AMI (previously American Microsystems Inc.) holds a strong position in complementary-MOS custom and semicustom integrated circuits. On the standard products side, however, that division has been criticized recently for its concentration on mature standard products such as read-only memories. AMI has suffered from a severe drop in the video game business. In

Optimistic. Former IBM executive James F. McDonald (left) has day-to-day operating responsibility for Gould, which has been revamped by chairman William T. Ylvisaker.

MAJOR ACQUISITIONS AND DIVESTITURES BY GOULD INC.

Companies acquired	Year acquired	Companies and divisions divested	Year divested
Systems Engineering Laboratories Inc. (now Gould's Computer Systems Division)	1980	Industrial Group (transportation and agricultural products)	1981
SRL Medical Inc. (now Gould Cardiopulmonary Products Division)	1981	Gould Financial Inc.	1981
Gettys Manufacturing Co. (now Motion Control Division)	1981	Electrical components unit	1983
De Anza Systems Inc. (now Imaging & Graphics Division)	1981	Electrical products unit	1983
American Microsystems Inc. (now Gould AMI)	1982	Electric motor unit	1983
Dexcel Inc.	1983	Power conversion unit	1984
Compion Corp. (now Gould Compion Software)	1983	Lead-acid battery unit	1984

the realm of defense systems, however, business recently has been buoyed by the upturn in U.S. military spending. Gould supplies such defense products as the MK48 precision-guided torpedo, passive sonar arrays for submarine surveillance, avionics and communication systems, and training simulators.

Sore spot. Strong gains in defense sales and components, however, are offset by weaknesses in the test and measurement area, stemming largely from delays in shipment of its new K105 logic analyzer, points out Barry L. Lucas, an analyst who follows Gould for Raymond, James & Associates Inc., of St. Petersburg, Fla. Indeed, the test and measurement area has been a sore spot for Gould, says Lucas, who notes that several factors, including management turnover, have recently come together to produce problems. (To help shore up this operation, Gould recently appointed former Tektronix Inc. executive Peter R. Strong to the position of group vice president for test and measurement.)

Despite a 5.7% rise in sales last year to $1.32 billion from 1982's $1.25 billion, Gould's 1983 earnings were down 31% to $64.1 million from $92.8 million in 1982. But with the continuation of an upswing that began during last year's fourth quarter, sales and earnings so far this year are up. For the first six months, profits rose 38% to $40.8 million, while sales gained 17% to $755.5 million versus 1983's first half.

McDonald sees much of his job as opening up lines of communication among the various Gould operations, each of which has its own profit and loss responsibility. "This is clearly a different kind of environment than IBM, where every business of any significance was internally developed and grown over a period of time."

By fostering internal awareness of the needs and capabilities of the various divisions, McDonald hopes to better leverage its overall size. One example: "We'd like to get more products out of our technology base. As we make an investment in a technology in the corporation, we want to make sure that we see all the avenues of getting products out of that technology across all divisions."

He says there is a strong need for Gould to become more market driven. "I think you'll find that some of our competitors have actively gone out and looked for ways to develop a product or design for customers and have looked for ways to develop unique products for their lines. I think that's an area that we clearly want to focus on as well."

White at E.F. Hutton agrees with McDonald's views. "There's a common thread that runs through a lot of their [Gould's] businesses," he says. "But it doesn't do them much good unless they can really link them together and get a lot of synergy out of them. They need to get those divisions working even more closely together than they have been."

Industry watchers are reacting favorably to McDonald's ideas. "He's not talking about any grand strategies for significant new things Gould should be doing," sums up Lucas of Raymond, James. "He's just talking about making the company run better on an operating basis by pulling more product across divisional lines, being more responsive to the needs of their customers and working to improve operating margins. He's saying all the right things. Now its just a question of his implementing [them]." **—Wesley R. Iversen**

Military supplier prospers on good things in small packages

Richardson, Texas

Medium-sized and small contracts can go a long way toward building a big business in government electronics. Such is the case at Electrospace Systems Inc., which for nearly 15 years has cultivated skyward growth in military airborne-command centers and secure communication switching systems.

With its grip on some 450 deals with 150 customers and federal agencies, Electrospace has fashioned total annual revenues nearing the $100 million mark—mostly from contracts of less than $6 million each. Just last August, however, the firm landed a big one: Pacer Link Phase II, a seven-year, $181 million program to provide electronic modifications as well as secure digital voice- and data-switching systems to the Air Force's fleet of 39 Airborne Command Post aircraft. The initial award will give

Electrospace $22.9 million. Much of the work will be done at a new hanger that is under construction in Waco, Texas.

Pacer Link is a "contract of Olympian proportions," says market analyst Robert M. Hanisee at Seidler Amdec Securities Inc. in Los Angeles, who believes the award was significant in light of extremely stiff competition from such firms as E-Systems, Rockwell International, and Boeing. He is concerned about the firm's ability to turn a profit on the contract, however, because the winning bid was substantially below others. Electrospace executives are confident they can earn money on the contract, noting that the firm has worked on those types of planes from their inception.

Heavy reliance. Other observers believe the company cannot maintain its lofty growth rate if it continues to rely too heavily on government-electronics markets. Today, 90% of its business comes as a prime or subcontractor to the U.S. government.

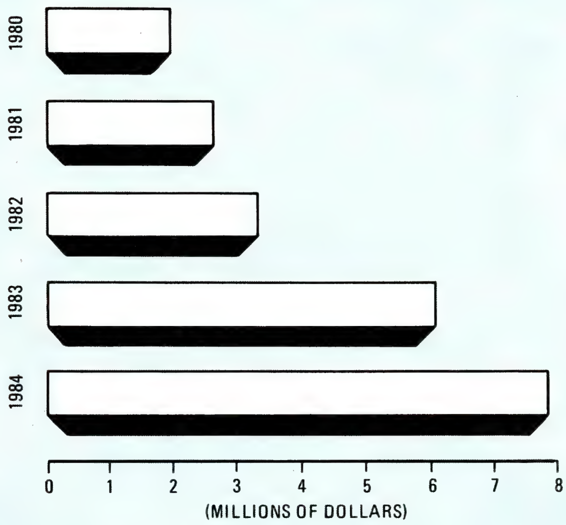
Electrospace is aware of the problem and hopes to raise its non-U.S.-military business to 25% of its total billings. But the move has not yet been successful. The most bothersome thorn lodged in its commercial efforts is continued losses in telephone switch markets, says Kenneth L. Paneral, vice president and research analyst at Rotan Mosle Inc., in Chicago. The firm's Electrotel subsidiary in Ballinger, Texas, acquired in 1979, is still trying to cash in on aging electromechanical switching systems in central phone offices. While industry gurus talk of all phone lines using all-digital technology in the future, today nearly half the phones in the U.S. are still terminated by these old-style switches. Electrotel markets solid-state relays and replacement modules for the most failure-prone components of electromechanical switches.

Flying high. Modifying airplanes for the U.S. Air Force is big business for Electrospace, which maintains its own hangars.

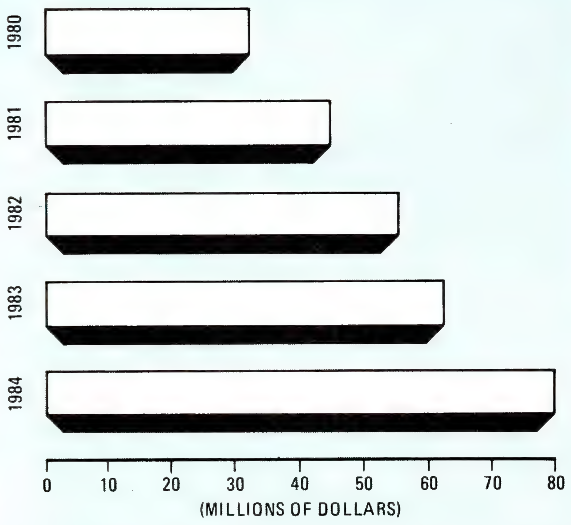
What analysts find unusual about Electrospace is that all four of its founders are still actively running the daily business, and doing it quite well. "One of the reasons that we work well together is that not one of us feels like we are an inventor-genius. It's taken a team effort to get to where we are," says Robert L. Carrel, executive vice president.

In 1970, Carrel and three former associates at Collins Radio (now part of Rockwell International in Richardson) went into business without a contract in sight. "It was strictly cold turkey," Carrel now recalls, "but we never had any thoughts that it would not work out." The four—Carrel, president and chairman James R. Lightner, vice president Milton W. Holcombe, and vice president Richard C. Fenwick—remain loyal to the firm's original intent of spreading out its defense business over a wide range of customers and products. The firm's activity is split into five areas, with the largest being electronic warfare systems. It also deals in aircraft modification, military electronic switching systems and test ranges, and commercial telecom.

"In this business, you've got to keep a lot of irons in the fire," Carrel says. Sales are running hot, climbing to $79.5 million in fiscal 1984 from $62.1 million, with profits up to $7.9 million from $6.1 million. –J. Robert Lineback



Upward. Earnings have grown impressively for 15-year-old Electrospace, started by four engineers who had no contracts in hand.



Growing. Electrospace executives know that the company must turn to other businesses to maintain its revenue growth in years to come.

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MANUFACTURING HEADS TOWARD FULL COMPUTER INTEGRATION

Area tape automated bonding plus a wider range of ceramic substrates and specialized test fixtures for surface mounting highlight the year

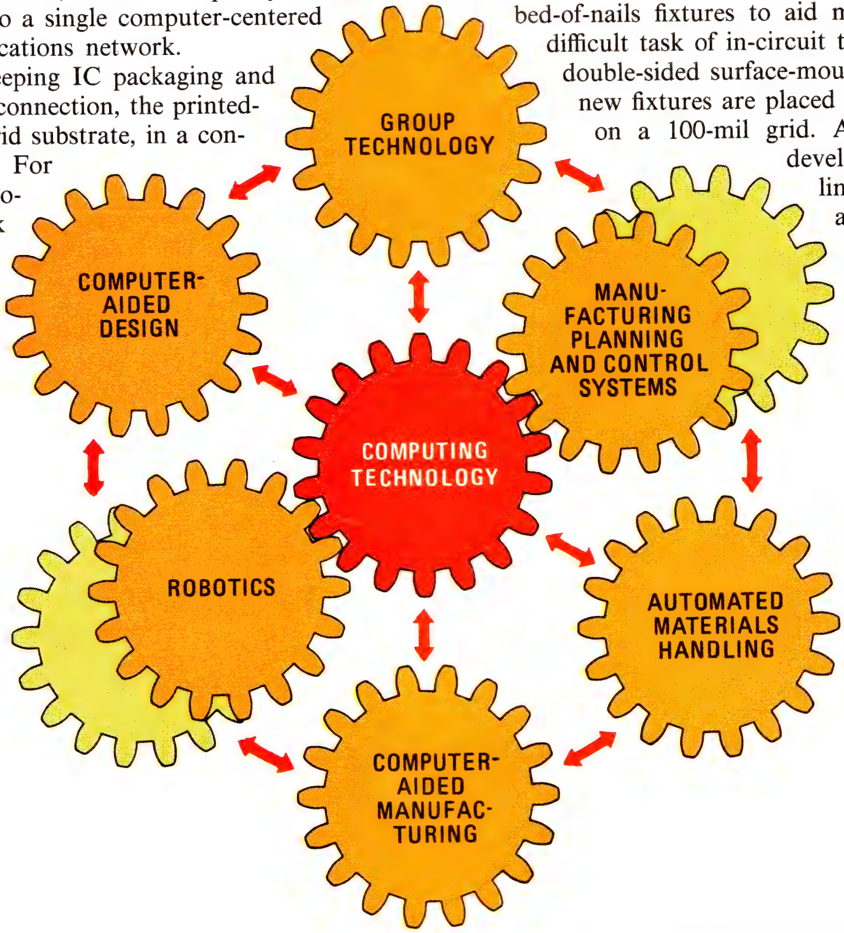
Manufacturing technology shows no signs of slackening the hot pace of the 1980s. New very large-scale integrated circuits and the expanding power of microcomputers, mainframes, and local networks have pointed the way toward increased efficiency and productivity.

But the big story of the year is likely to be the advent of computer-integrated manufacturing (CIM), with giant firms such as IBM, Hewlett-Packard, and Tektronix leading the way. CIM links all phases of design, manufacturing, and automation, as well as quality, cost, and inventory control into a single computer-centered distributed communications network.

VLSI chips are keeping IC packaging and its next level of interconnection, the printed-circuit board or hybrid substrate, in a constant state of flux. For example, tape automated bonding took on a new emphasis this year as one of the better methods of packaging high-lead-count chips. Further, IC-package manufacturers are actively looking for better ceramic alternatives with higher speed and power-dissipation capabilities than aluminum oxide substrates.

Meanwhile, packaging solutions for chips with gigahertz clock rates started to appear. At the pc-board level, laser exposure systems left the experimental stage and began to be used as production equipment for a whole new generation of fine-line boards.

In the field of automatic testing, two developments have stood out. One was the appearence of double-sided, bed-of-nails fixtures to aid manufacturers in the difficult task of in-circuit testing of single- and double-sided surface-mounted pc boards. The new fixtures are placed on a 50- rather than on a 100-mil grid. Another far-reaching development was the linking of computer-aided design systems with computer-aided testing. The integration of these two processes is expected to cut manufacturing costs greatly.


GROUP TECHNOLOGY
COMPUTER-AIDED DESIGN
MANUFACTURING PLANNING AND CONTROL SYSTEMS
COMPUTING TECHNOLOGY
ROBOTICS
AUTOMATED MATERIALS HANDLING
COMPUTER-AIDED MANUFACTURING

Computer-integrated manufacturing links all phases of the design-manufacture cycle into a distributed network

A typical computer-integrated manufacturing network contains familiar blocks, such as computer-aided design, manufacturing planning and control systems (MPCS), computer-aided manufacturing, and the computer technology that links all these blocks together. However, CIM also contains three new blocks: group technology, robotics, and automated materials handling.

The top three blocks shown in the figure on page 45—CAD, group technology, and MPCS—are primarily software; the bottom three blocks are primarily software-operated machinery or equipment. CAD and CAM are just a small part of the overall picture. The key to CIM is the software and network links that completely integrate all elements of the network.

Many factors are influencing companies either to implement or consider CIM. These include:

- International competition.
- The need for higher productivity.
- The demand for higher quality at lower cost.
- The demand for better customer service.
- The need for more flexibility in manufacturing.
- The decreasing cost of data processing and storage.
- The distributed processing concept.
- The emergence of a strategic-planning methodology.

The attributes and abilities of CAD, CAM, and robotics are fairly well known to most electrical and electronics engineers, but few of these specialists really understand what group technology and manufacturing and control systems are and what advantages these systems can add to a manufacturing setup.

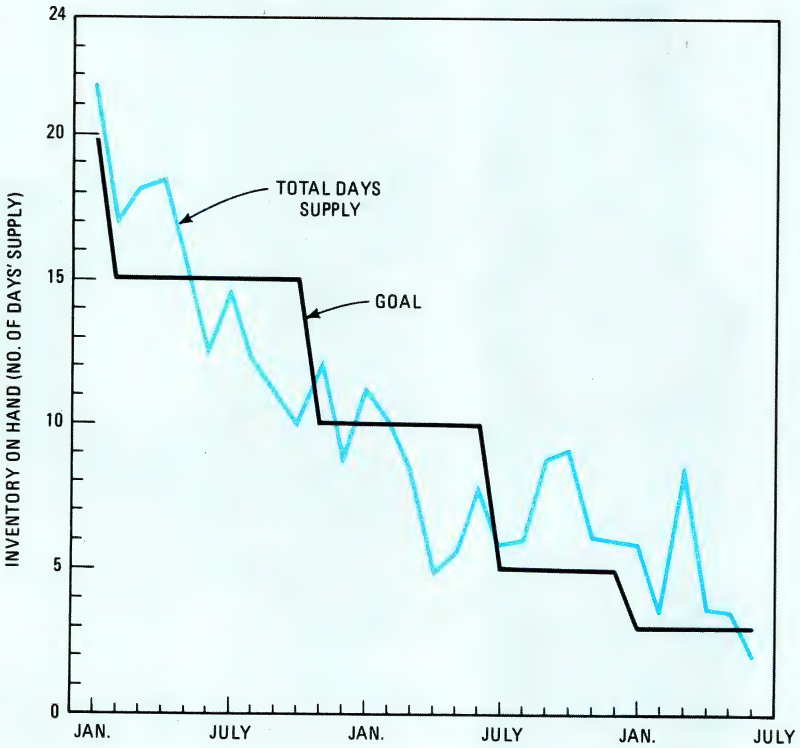
Group technology, as it relates to software or equipment, doesn't represent a large piece of the CIM market, but it is one of the major ways that CIM cuts costs. The major components of group technology are manufacturing cells (assemblages of machine tools) along with product and process classification and coding, which are the source of the cost saving. With this data base, a firm's manufacturing engineers can sort through what they have already designed to save time in the design process.

For example, in many new designs, only 20% of the parts are truly new; on the average, 40% of the parts already exist and 40% can be created by modifying existing ones. The problem is that the designer usually can't find the designs for the 80% that have already been designed, so these parts are redesigned—a wasteful procedure. With group technology software, however, it is possible to sort through a data base and group parts into families that have similar physical characteristics.

Group technology reduces the number of parts in the data base, the introduction costs of new parts, and the design lead time for new products. It increases capacity utilization 10% to 15%. In addition, it reduces setup time, defective products, and design costs.

One of the most important components of the CIM network is the MPCS block. This element is composed of five segments: manufacturing resource planning (MRP), simulation and optimization, shop-floor data-collection systems, management graphics and decision-support systems, and distribution-resource planning.

MRP is the key to this block, and one of the tenets of MRP is the just-



Just in time. Hewlett-Packard Co.'s Greeley (Colo.) Division instituted a just-in-time program in November 1982. The curve traces the division's progress in reducing work-in-process inventory. By May 1984, the goal for inventory reduction was already surpassed.

in-time (JIT) system, which originated in Japan. Currently, 11 HP divisions, Apple Computer's Macintosh plant in Fremont, Calif., and many other electronic component and equipment plants in the U.S. are using JIT and reaping its benefits: increased quality, reduced inventory and labor costs, better space utilization, and better quality from vendors.

Evil inventory

In its simplest form, JIT is based on the belief that inventory is evil. The Japanese believe that inventory tends to hide problems with production efficiency and product quality. They use the analogy that inventory is like water flowing down a riverbed. The lower the water level (inventory), the more rocks (problems with productivity and quality) are exposed and can be avoided.

There are many elements to JIT. One is receiving raw material in production "just in time"—meaning daily delivery of parts. A second is building units one at a time and sequentially—that is, in series rather than in batches. Other elements are simplified electronic data processing systems, simplified materials movement, and linear assembly—the same quantity day after day for a set period of time.

The final element is to develop total quality control. One of the ways JIT achieves this is by radically reducing the number of vendors who supply the firm's components and subsystems. The selected vendors must produce parts whose quality is so high that no incoming inspection is required.

HP's Greeley (Colo.) Division, which builds various peripherals and disk drives, is a good example of introducing JIT. It began a pilot program in November 1982 and recently became a full JIT factory.

The figure on page 46 shows a plot of work-in-process inventory versus time as the JIT program took hold. By May 1984, actual inventory was less than the desired goal. In addition, the quality of the products on the JIT line has improved 10:1. Two years ago at Greeley, $40 million worth of products were made in a space of 86,000 ft^2. Today, thanks to HP's manufacturing strategy, $120 million of equipment is made in a space of 67,000 ft^2. Finally, the number of vendors has been cut from 384 to 200.

Robots are coming

Robotics is already an important part of the overall CIM picture, particularly in Japan and in automobile production worldwide. But the greatest growth in this field is yet to come. At present, the U.S. is far behind the rest of the world in installed robots. For example, there are about 12,500 installed in Europe, and 140,000 robots already installed in Japan, but only about 8,000 to 9,000 in the U.S. Some predictions look for 1 million robots in Japan by the year 2000.

By now, the benefits of robotics are well established: increased quality, higher productivity, flexibility, high reliability, and compactness. Considerable work still lies ahead in robotics, however, particularly in software development and support. Robots eventually will be linked directly in networks like those that connect numerically controlled machine tools. New sensors for vision and tactile feedback are needed in order to make true assembly robots feasible.

PACKAGING

Advances in tape automated bonding, SiC use, aluminum nitride for high-speed substrates power year

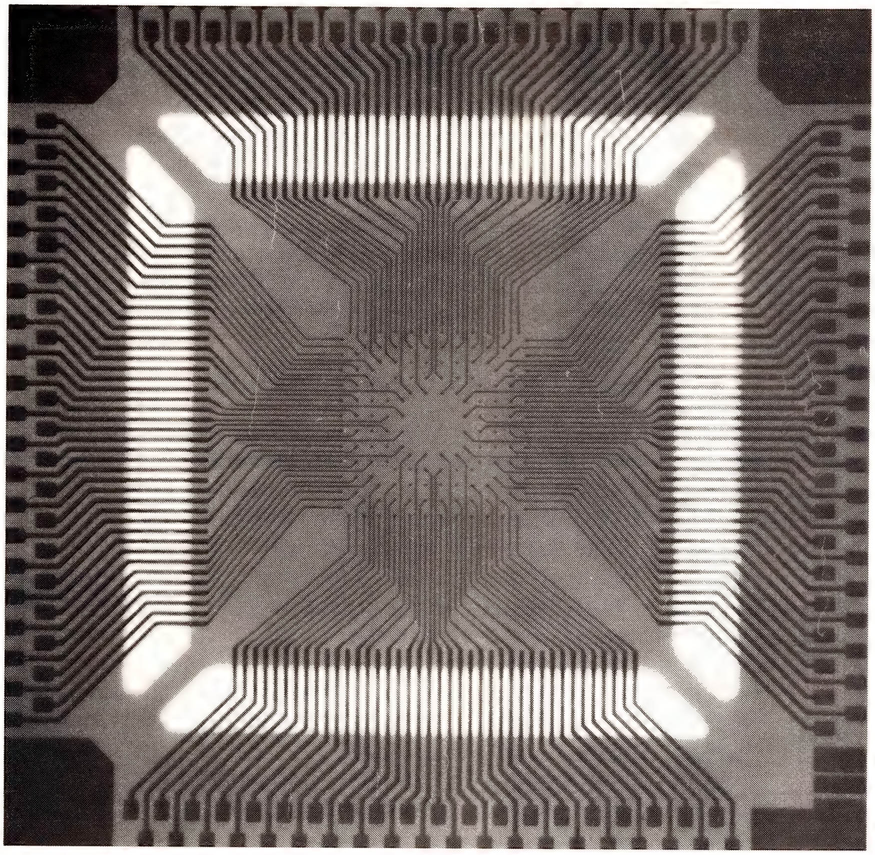
Tape automated bonding (TAB), a technique in which chips displaying special solder points (called bumps) are mass bonded to copper microinterconnections supported by an insulating Kapton film, has been around since 1971. However, the cost of tooling new tape designs and the special assembly equipment required have kept this technique from catching on.

Now it appears that very large-scale and very high-speed integrated circuits have created an environment where TAB—with its ability for mass lead-bonding, on-chip test and burn-in, and high lead density—could become the key to packaging and handling chips with greater than 100 input/output pads. During the past year, many U.S. companies demonstrated that they could produce high-lead-count beam tapes with 2-mil lines on 4-mil centers—a critical requirement for interconnecting to VLSI and VHSIC parts.

But the big story in TAB technology is the emergence of area TAB—a combination of TAB and solder-bumped chips in which the chip makes contact on the inner area of the tape rather than on the periphery—as a workable technique to connect to chips with a grid of I/O pads on the interior. Wiring density, speed, and test capabilities may gradually force chip I/O facilities away from their peripheries. This concept was first proposed by 3M Co., St. Paul, Minn., for a VHSIC application [*Electronics,* Dec. 29, 1981, p. 74].

Unlike conventional beam tapes, which have only one conductive layer, area TAB tapes have multiple layers [*ElectronicsWeek,* Sept. 17, 1984, p. 72]. Typically, a large, densely packed integrated circuit with a grid of solder bumps is die-bonded to a ceramic package. Then its bumps are reflow-soldered to a gridded pad pattern on the tape. This pattern is internally connected on the tape to outer conductors, and these are bonded to pads on the package.

Currently, 3M and Micro Bond Technologies, Canoga Park, Calif., are delivering prototypes of beam tapes for area TAB. 3M is developing one with 250 I/O connections per chip, while Micro Bond has fabricated samples



Area TAB. A 160-lead area TAB tape designed by Micro Bond has a center area that contains pads for mating with the solder bumps of an integrated circuit. The pads are connected internally to thicker leads for external connections.

of an area TAB beam tape with 160 I/O connections.

Beam tape will have still more variations in the future. For example, Micro Bond is developing a family of high-frequency tapes based on tapes with low dielectric constants and microstrip or strip-line characteristics. Texas Instruments Inc., Dallas, is considering the use of beam tape as a way to package the drive electronics for future electroluminescent displays in a minimum of space.

Aluminum oxide, or alumina, is the dominant material for packaging ICs, hybrids, and power semiconductors. However, under pressure from demands for better power dissipation, higher chip performance, and a thermal-coefficient-of-expansion match even closer to single-crystal silicon, other materials such as silicon carbide and aluminum nitride are entering the package and substrate arena, as the table shows.

One of the most attractive materials is Hitachi Ltd.'s Hitaceram. This is a modified SiC material, which has a low dielectric constant (4, compared with alumina's 8), a TCE that almost matches that of silicon, and a thermal conductivity almost 10 times greater than that of alumina. These factors make this material ideal for high-speed packaging applications where dielectric-constant and power-dissipation capability are critical.

Hitachi is already using this material in a 108-pin package containing six bumped high-speed memory ICs bonded to a silicon substrate [*ElectronicsWeek*, Sept. 17, 1984, p. 71]. Other materials under consideration include conventional SiC, currently being evaluated by Mitsubishi Electric Co., Tokyo, and aluminum nitride, under evaluation for high-power applications by General Electric Ceramics Inc., Chattanooga, Tenn., and W.C. Heraeus GmbH, Hanau, West Germany.

Both of these ceramics have relatively low dielectric constants and TCEs that nearly match that of silicon. Aluminum nitride also has a high thermal conductivity compared with alumina. All these ceramics, along with beryllia, should see more applications with forthcoming high-speed, high-power VLSI and VHSIC applications.

TABLE: COMPARISON OF CERAMIC SUBSTRATES

Material characteristics	Hitaceram	Conventional silicon carbide	Aluminum nitride	Beryillia ceramic	Alumina ceramic	Single-crystal silicon
Bulk density (g/cm^3)	3.2	3.1	3.2	2.9	3.8	—
Thermal coefficient at room temperature (400°C x 10^6/°C)	3.7	4.2	4.5	8.0	7.0	3.5~4.0
Thermal conductivity at room temperature (W/cm °C)	2.7	0.67	1.0	2.4	0.29	1.4
Resistivity at room temperature (ohm-cm)	$>10^{13}$	$>10^{13}$	$>10^{14}$	$>10^{14}$	$>10^{14}$	—
Dielectric constant (MHz)	40	—	8.8	7	10	—
Dielectric loss (MHz)	0.05	—	0.0005	0.0005	0.0002	—

PCK's Frisch seeks a plastic packaging concept

In 1977, after spending four years in Kollmorgen Corp.'s Photocircuits Division, in Glen Cove, N.Y., Dave Frisch joined the firm's PCK Technology Division in Melville, N.Y., to head up a group responsible for "scaling up" new processes from research and development into production. Under Frisch's direction, work began in 1979 on plastic substrates and processing for plating onto various specialty substrates.

The fruit of his Circuitry Products Group's labors is a family of thermoplastic substrates made from polyethersulfone, polysulfone, and polyetherimide resins. Thermoplastic printed-circuit boards, he says, offer superior electrical, thermal, and mechanical properties as well as injection-molded, three-dimensional circuitry. The advantages of plastic pc boards over other standard pc laminates, Frisch explains, are performance characteristics such as a low dielectric constant, higher Underwriters Laboratories temperature ratings, natural flame retardancy, higher glass transition temperatures, and a heat dissipation factor equivalent to that of Teflon.

"The concept of plastics and molded technology has captured interest worldwide because it's never been done before," asserts Frisch, 40, who holds a bachelor's degree in mathematics from Hofstra University and also is a co-holder of Kollmorgen patents in radiation curing as well as specialty substrates and pc-board processes. Incorporating electronics directly onto a shaped board also represents a novel concept in electronics packaging, he continues.

"The objective is to come up with, not a printed-circuit board anymore, but molded electrical devices, which gives the end-user a system savings, not so much a board savings," Frisch explains. He believes the future of plastic circuit boards, beyond applications using plastics for their performance, is in the molding process. "What we're working on is the ability to create a new packaging concept." **—George Leopold**

Meanwhile, the first gallium arsenide ICs are beginning to appear, and this naturally means new packages. The 1984 Gallium Arsenide IC Symposium, to be held in Boston Oct. 23 to 25, is scheduled to have several papers describing the state of the art in packaging GaAs ICs. One, by Tushar R. Gheewala of Gigabit Logic, Newbury Park, Calif., describes two 36-pin, 1-cm^2 packages for GaAs ICs with 100-ps rise and fall times and up to 4-GHz clock rates.

The first package is based on conventional cofired multilayer ceramic techniques. The second uses a novel silicon chip subcarrier, which provides coplanar transmission lines, bypass capacitors, and terminating resistors. Here the GaAs chip is mounted to the silicon substrate, which in turn is bonded to a ceramic chip carrier.

The ceramic package is a four-layer type with I/O pads on the bottom layer, a ground plane and die-attachment area on the second layer, signal strip-lines on the third, and a reference-voltage plane with room for bypass capacitors on the fourth layer. Typical I/O signal propagation delays in this package are estimated to be less than 50 ps, permitting the transmission of signals with rise and fall times of about 150 ps at 2 to 2.5 GHz.

In the silicon subcarrier package, the coplanar signal lines are deposited over a high-resistivity silicon substrate, separated by a layer of silicon dioxide. Bypass capacitors are formed by reverse-biased p-n junctions. Because of the lower dielectric constant of the silicon dioxide on the silicon subcarrier, the overall package is about 25% faster than the ceramic package.

In a second paper on GaAs IC packaging, a group of authors from Magnavox Advanced Products and Systems Co., Torrance, Calif., describe a completely different approach to the same problem. Magnavox engineers have developed a 44-pin, 12-port leadless chip carrier based on the additive multilayer copper-polyimide process developed by Augat Microtek, Newbury Park, Calif. The packages are batch-fabricated with 356 units to a panel, providing a low-cost, high-frequency package.

In this design, three metal layers form 50-Ω strip-line transmission lines. Two additional metal layers form a low-impedance power plane, minimizing noise voltage generated by fast switching currents. Copper vias interconnect metal layers and serve as thermal columns between the die and the mother board. The carrier has been characterized up to 5 GHz with the following results: voltage standing wave ratio of 1.2:1, greater than 40-dB port-to-port isolation, and a maximum of 4% deviation in signal-line impedance from 50 Ω.

Laser competition

At the circuit-board level, scanned drum-type laser exposure systems surfaced during the year to provide competition for the existing flatbed laser systems, and high-sensitivity resists for this application appeared. Laser exposure is needed to generate artwork for the coming generation of fine-line boards. In addition, it cuts artwork turnaround time from several hours to minutes.

During 1984, Macdonald Dettwiler and Associates Ltd., Richmond, B.C., Canada, and Optronics International Inc., Chelmsford, Mass., both introduced scanned drum systems for laser artwork generation. The Macdonald Dettwiler system can plot a 24-by-36-in. pattern with 1-mil resolution in about 2½ minutes; the Optronics unit plots an 18-by-22-in. pattern with the same resolution in less than 15 minutes.

Even more important than machine design was the fact that E.I. Du Pont de Nemours & Co.'s Riston Products Division, Wilmington, Del., announced two high-sensitivity printed-circuit dry-film resists intended for direct laser exposure. Most dry-film resists for full wide ultraviolet exposure have a sensitivity of about 100 mJ/cm^2. The two experimental resists have a sensitivity of 10 mJ/cm^2. One of them responds to laser radiation in the visible rather than the UV spectrum, allowing for more efficient use of the laser output. The effect of the visible-light-sensitive resist is to cut laser exposure time based on conventional resists by a factor of 20. A reduction of this magnitude could make direct exposure of pc resists more attractive as a production technique.

AUTOMATED TESTING

Surface mounting provokes test challenges; integrating CAD and testing cuts production costs

Surface-mounting technology has been common in Japan for many years in consumer-product assembly and is rapidly gaining momentum in the U.S. as electronics manufacturers seek to shrink package sizes and reduce production costs. Surface mounting begins with a printed-circuit board that has a number of solder pads matching the footprints of the surface-mounted devices to be attached. Through holes can be eliminated, components can be soldered on both sides of the pc board, and board size can be reduced by as much as a factor of three, because surface-mounted devices do not require bent leads.

A reduction in pc-board size results in lower material costs, and lighter weight decreases packaging and shipping costs. Other claims for surface-mounted assemblies are still being evaluated. These include less susceptibility to vibration plus high reliability because fewer connections are used and through holes are unnecessary.

However, tradeoffs appear to be hampering a speedier implementation of surface-mounting technology. Many firms with existing pc-board production equipment are not eager to invest in new automated surface-mounting equipment. Automated equipment, such as component-placement machines, is needed to handle and insert the delicate and tiny components, which are difficult for production workers to handle and are vulnerable to damage by excessive tweezer pressure.

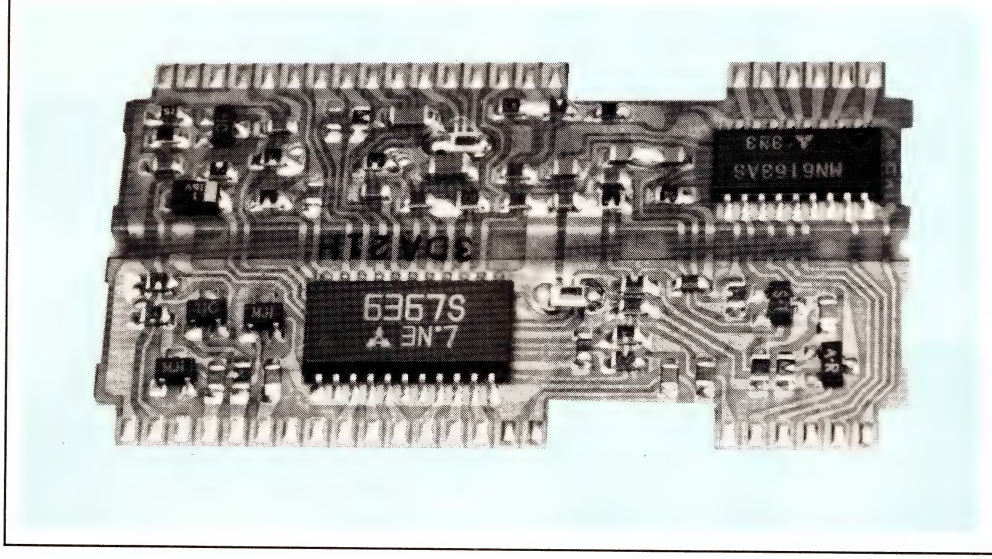
A major challenge with surface-mounting technology is the task of testing pc boards—many of them loaded with components on both sides or with surface-mounted components on one side and leaded components on the other. Further, with this technology based on 50-mil rather than 100-mil centers, the demands on test fixtures and probes are magnified.

Test demands

Accessibility to circuit nodal points is restricted in surface-mounted assemblies. This is because their components, with either short leads or tabs, are attached to the pc board with solder applied directly to the leads and solder pads, leaving only a small contact area along the side of the IC for probing. With traditional leaded chips, test probes could make contact to the solder joint on the solder side of the pc board; with surface-mounted ICs, access for testing must be available on the same side of the pc board as the chip is placed.

Numerous prototypes of surface-mounted boards have simply defied adequate testing; redesigns were necessary to add test pads along line traces and accessibility of nodes from both sides of the pc board, using through holes. With surface-mounting technology offering a substantial saving in board real estate, test engineers argue that some of the newly available space could be best used for test pads.

Shorts on surface-mount-



Tightly packed. Printed-circuit boards with surface-mounted devices, such as Matsushita Electric Co.'s VCR functional block, offer high packing density but tough testing and fixturing challenges.

ed assemblies are more common than on leaded-IC boards because of the surface-mounted chips' closer spacing between component leads, line traces, and pads. With wave soldering, shorts may occur because of bridging between closely spaced areas; solder balls are a major cause of shorts in reflow-soldering processes.

Other problems in surface-mounted assembly that complicate testing are missing components on pc boards, unmarked surface-mounted components (where chip resistors and capacitors look alike), backward insertion of polarized components, and damaged surface-mounted ICs (attributable to their relatively fragile structure).

Because surface-mounted chips are on the same side of the pc board as the solder pads, the simple process of probing the boards may permit bad boards to pass even though they include poor solder connections, a problem not common with leaded-component boards. The pressure exerted by a test probe pin against the lead or tab of a surface-mounted device may establish contact between defective solder joints and complete the circuit. After the probe is removed, the incomplete solder condition will reappear, even though the board has passed test inspection. In addition, probe pressure may damage a surface-mounted component or crack a ceramic package on the board. Such problems dictate thorough in-circuit or functional testing of surface-mounted assemblies.

Fixtures and probes

Conventional bed-of-nails fixtures are not easily adapted to surface-mounted boards with components on both sides and nodes that may only be accessed from one side of the board. One alternative is to use two conventional fixtures, one for each side of the pc board, with clip leads and cables to route the signals from one side that are needed to check the other side. This tactic cuts throughput in half, however, and the time required for manually clipping and disconnecting would add considerably to test costs.

Another alternative is to use a two-sided fixture or clamshell such as that offered by Zehntel Inc.'s Production Services, Concord, Calif. The vacuum-activated fixture can access 1,360 test points spaced on 50-mil centers. Custom fixtures, of course, can be fabricated at relatively high cost.

Test engineers, familiar with probing component leads sticking out from the bottom of a pc board, are challenged by surface-mounted assemblies with no leads to probe, closely spaced pads and traces, and the need to probe both sides of a board. Solutions include the addition of test pads along the trace path of surface-mounted components (positioning them on 100-mil centers to permit use of existing, relatively inexpensive bare-board test equipment) and staggering closely spaced IC pins in order to obtain 100-mil spacing.

Although probes with 50-mil centers are available, they are scaled-down versions of 100-mil-center probes. Thus they are relatively fragile, offer higher resistance, and typically have a compression range of 100 mils, limiting their use to tightly controlled fixtures.

Another danger with 50-mil center probes is that the concentrated force on a solder joint or pad may crack the surface-mounted chip or damage the solder joint. In addition, excessive force by the application of multiple probes in close proximity may preclude the use of vacuum fixtures because of the limitation of atmospheric pressure to keep the board from flexing and dictate the need for mechanical fixtures.

Just as manufacturing procedures must be modified to make surface-mounting technology economically attractive, so must test techniques and hardware make innovative strides to check out the completed assemblies. For testing of surface-mounted devices to become economical, design-for-testability must be dictated in the early stages of product development.

Integrating design and test

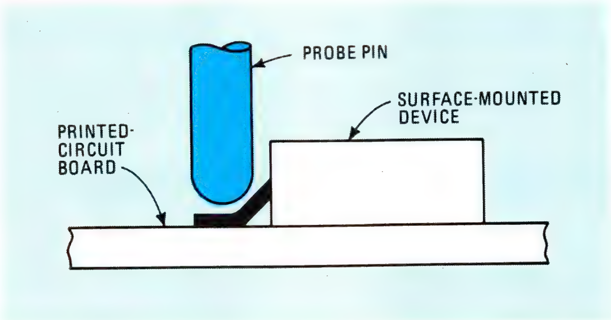
Electronics manufacturers are also investing heavily in computer-aided design systems and lower-cost engineering work stations for their product design groups. Waste is mounting rapidly, however, as they spend additional dollars for hardware purchases and software development for their test departments. There is little, if any, integration between logic schematic capture, pc-board layout and test stimulus-and-response information. The result is an immense duplication of effort and cost because of the failure to link CAD with computer-aided testing.

CAD systems, whether they are expensive and sophisticated turnkey operations from firms such as Calma, Applicon, or Computervision, or lower-priced work stations from companies such as Personal CAD, Daisy Systems, Mentor Graphics, or Valid Logic, provide a library of device types, the ability to interconnect the basic building blocks, and the ability to verify circuit and logic designs as well as timing sequences. The development of stimulus and response vectors is also an integral function of CAD systems.

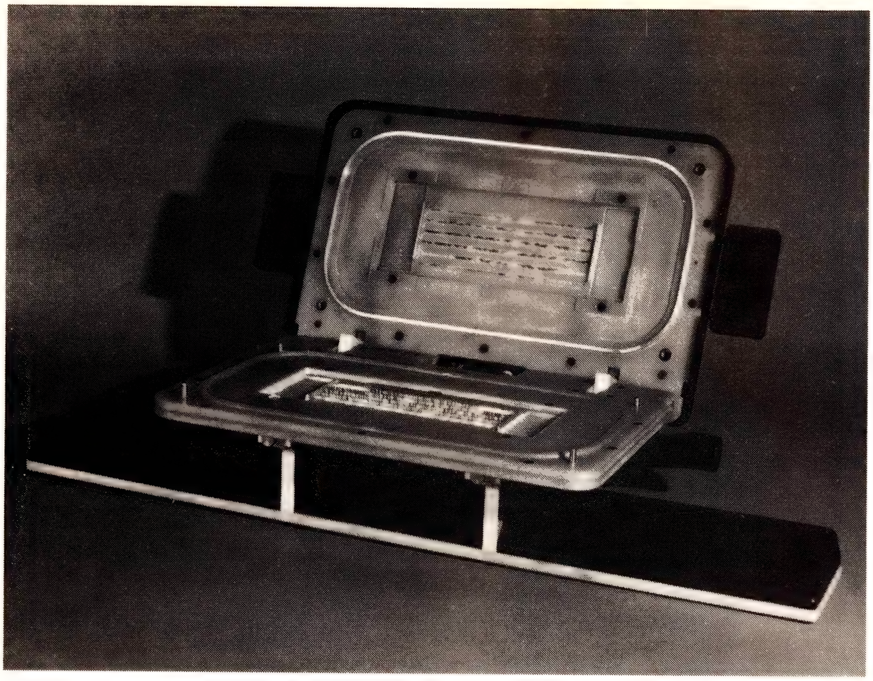
Computer-aided test systems do much the same thing. To test incoming parts (ICs and discrete semiconductors) and pc-board assemblies, they must likewise store a library of device types, handle interconnection schemes, generate test vectors, and check timing signals.

In the design process, a design engineer using a CAD system selects the chips to be used, interconnects them to create the final design, tests the circuit performance using CAD-generated vectors and then, if satisfied with the results, requests a circuit schematic, interconnect diagram, and parts list to be sent to the test group. The test engineer then repeats much of what the design engineer has done and generates a more complex set of test vectors to more fully exercise the final design.

At this late point, serious



Passing rejects. Pressing a probe against a surface-mounted device lead that is not properly soldered to a pc board will make the contact appear good and allow the board to be passed.



Two-sided attack. Both sides of a pc board can be tested simultaneously with Zehntel Inc.'s clamshell in-circuit tester for 50- or 100-mil center surface-mounted devices.

flaws may surface. These can range from difficulty in testing the design to problems with feedback loops and circuit irregularities. The obvious but costly solution is to send the design back to the CAD team for rework, change some of the design decisions, and route the redesign back to the test group for another try. A popular alternative to this solution is simply to make do with fewer test vectors and test nodes and, in the final analysis, a lower degree of testing than is optimum for high quality in the final product.

Then why are separate systems set up for design and test? Mainly because the hardware and software tools for the designer are different from those dictated for the test group, and vendors, too busy satisfying the separate needs of each, are not creating tools that designers and testers can use in common. Meanwhile languages, formats, and interfaces are still far from standard.

Networking needs

One of the most serious problems impeding the integration of CAD and computer-aided testing is the lack of standardization among hardware and software vendors providing networking capabilities.

Interfaces between CAD and test computer systems include RS-232-C, Ethernet, and GPIB types, with each used to take advantage of its particular characteristics. For slow speed and short (50 feet or less) runs, RS-232-C may be used; GPIB is favored for high-speed, multidrop (up to 15 devices) connections along a short distance (less than 100 feet). The bulk of high-speed, high-density automated-test-equipment data is handled by Ethernet, GenRad's GRNET, Teradyne's Teranet, and other proprietary schemes.

A single standard network, however, is still to be found. Users have not agreed on data transmission specifications and handling formats, while vendors, heavily entrenched in their proprietary network designs, find it difficult and expensive to cope with the swelling number of different interfaces and protocols created by ATE designers. One solution may be a series of gateways to link one standard network with the variety of existing computer systems and software packages.

It becomes obvious that integrating in order to share a data base not only can cut costs on the production floor and improve the product but offers benefits in improving the process as well. Currently, automated testing sorts the good parts from the rejects; the automated factory that uses integrated CAD and computer-aided testing systems will be able to detect any variations in the products and feed back data so that corrective actions can be taken early on to improve the process and production yield in real time.

Cutting the costs

The savings that are possible through the proper integration of CAD and computer-aided testing are illustrated by an analysis prepared by Jon Turino, president of Logical Solutions Inc., Campbell, Calif., for a report on LSI and VLSI test equipment. The estimated cost (at $50/h for design and engineering test time) for a pc board containing 150 chips, including 15 LSI and VLSI ICs of which five are new types, is shown in the table as $66,000. In keeping with the current practice in most plants of having two separate engineering groups, one for design and one for test, there is at least a $10,000 duplication of effort and cost.

Once CAD and testing are integrated, an immediate $10,000 saving takes place when new circuit models are created. Because the CAD circuit topology already exists, another $2,000 is saved by eliminating the need to duplicate it in testing. Half the $8,000 that is allocated for circuit verification and changes in CAD is spent developing test vectors, which can be downloaded to the circuit test generation in computer-aided testing. Thus, as Turino's report shows, costs can be dropped by 24%, or $16,000 on a $66,000 investment.

TABLE: COSTS OF COMPUTER-AIDED DESIGN

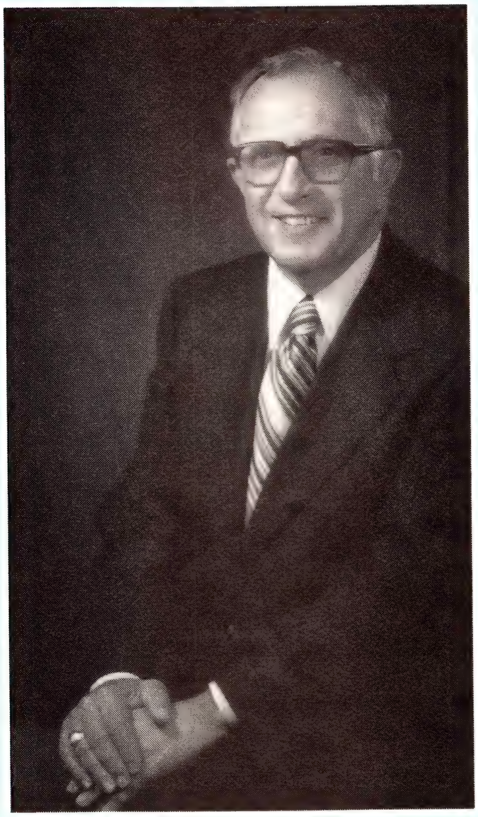
Operation	Design	Test
Creation of model	$ 10,000	$ 10,000
Design	$ 16,000	$ -0-
Function verification and changes	$ 8,000	$ -0-
Topology entry	$ -0-	$ 2,000
Test generation	$ -0-	$ 20,000
Totals	$ 34,000	$ 32,000

Spreading the word on surface mounting

In the U.S., the revolution in surface-mounting technology that is now sweeping the electronics industry marks a major beachhead at General Motors Corp.'s Delco Electronics Division, Kokomo, Ind. There, a pioneering program was launched in 1982, based on high-speed, automated surface-component-placement machines supplied by Philips, of the Netherlands [*Electronics,* Aug. 11, 1982, p. 52].

The deal also was a landmark for Philips. Delivery of the advanced machines, developed with the aid of Delco engineers, marked the first time in the Dutch giant's century-long history that it had ever supplied its internal production technology to an outside party, recalls Lewis J. Shioleno.

As president and chief executive officer at Centralab Inc., a Milwaukee subsidiary of North American Philips Corp., New York, Shioleno was instrumental in arranging the deal. "He took a risk within his own company and made things happen, and it all came to a very successful conclusion and probably advanced the state of the art by several years or more," observes Robert B. Costello, GM executive director of purchasing who at the time was director of materials management at Delco.



And that's not the only pioneering contribution made by Shioleno to U.S. surface-mounting technology, which lagged behind Japan's early efforts in the field. Fresh from his successful sale of the Delco deal to Philips officials in Eindhoven, Shioleno was soon in New York pitching another revolutionary idea to North American Philips officials there.

"Having been a part of the Delco mad rush to the forefront, I could see that the U.S. needed to develop a surface-mounting capability, and that if we didn't do it, the whole U.S. electronics industry would disappear and we'd become just a bunch of merchants" selling products made elsewhere, recalls the 59-year-old executive, who holds a bachelor's degree in mechanical engineering from the University of Notre Dame.

Shioleno's idea was to set up a technology center in Milwaukee that would instruct U.S. manufacturers in how to go about implementing the technology. Once again, he was successful. The result was a multimillion-dollar commitment by Philips to establish what is now SMD Technology Inc., a wholly owned Centralab subsidiary.

SMD Technology, which began its first seminars in April 1982, has yet to turn a profit. But by bringing together under one roof machines from a wide variety of manufacturers and by offering intensive, three-day seminars covering virtually every facet of the surface-mounting art, the operation is credited by many in the industry with performing yeoman's work in advancing U.S. capability in the field.

Though Philips' equipment and components get their share of time, the seminars also feature lectures and demonstrations from other manufacturers. "We believe that the only way to make them of value is to bring in co-suppliers," Shioleno explains. "I refuse to call them competitors because that sounds antagonistic. They make their presentations shoulder to shoulder with our people."

The list of firms that have sent representatives to attend the SMD seminars reads like a who's who of major U.S. electronics manufacturers, including names such as IBM, AT&T, Digital Equipment Corp., NCR, Ford, Chrysler, Hewlett-Packard, Tektronix, Fairchild, Zenith, RCA, and Apple. Last month, SMD Technology marked its 1,000th seminar attendee, and the facility is booked for months.

Philips, of course, ultimately stands to benefit from the investment because of the increased use of surface-mounting techniques fostered by the educational effort. But from Shioleno's activist perspective, U.S. manufacturers first had to be "made aware that this technology is the solution to global competitiveness. . . . Surface mounting is here. There's nothing we can do about it, and U.S. manufacturers have two choices: they can get out of the way, or they can start doing it, and that's about the only two choices they've got." **–Wesley R. Iversen**

Carrying the analysis one step further into a real-world situation, the same company designing 25 new pc boards a year—boards that are reasonably similar in complexity to those in the above example—would save $400,000 a year in nonrecurring engineering costs by integrating CAD and testing. As for manufacturing costs, according to Turino, at the pc-board level, an average of $3 per assembly can be saved in recurring test and diagnostics costs through the adoption of proper design-for-testability programs.

Thus, if the company in the example were building 10,000 products a year, each containing one each of the 25 pc-board types, the recurring annual saving would be another $750,000. By investing $50,000 to $100,000 to efficiently integrate the CAD and computer-aided testing facilities, a saving of over $1 million can be achieved. Additional benefits include faster entry into the marketplace, fewer manufacturing start-up problems for new designs, higher product quality, and, of course, improved profitability. **–Jerry Lyman and Howard Bierman**

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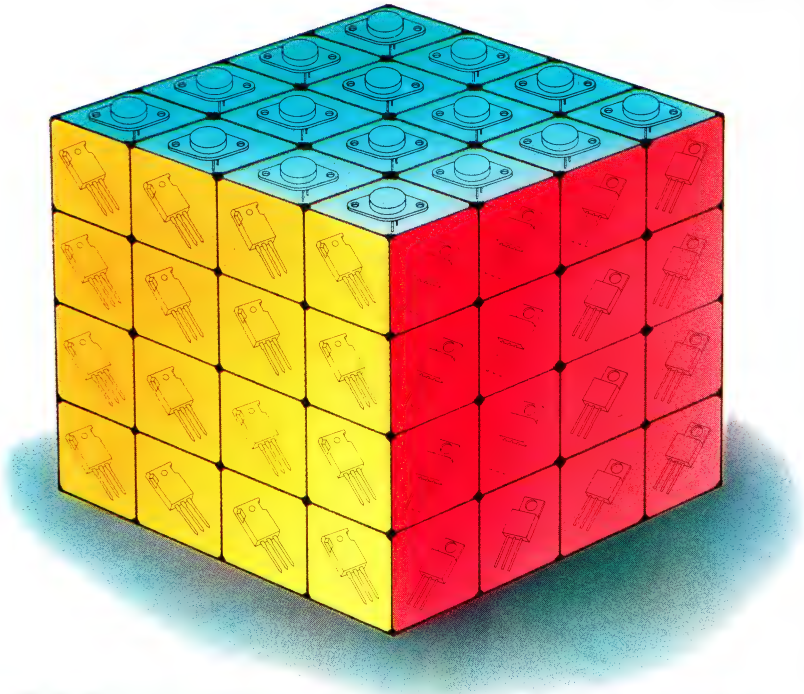

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	300-600	8	35	1.20	
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	300-600	16	35	1.20	
FEP30	50-200	30	35	.95	TO3P
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FE30	50-200	30	35	.95	TO3
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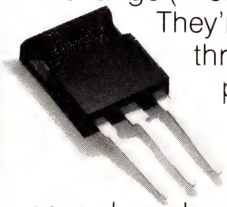

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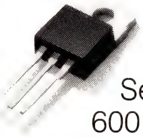

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GENERAL INSTRUMENT

SYSTEM UNITES IMAGE, TEXT PROCESSING

The paperless office comes one step closer to reality with the integration of image and text processing

☐ *by John Landau and James Williamson*

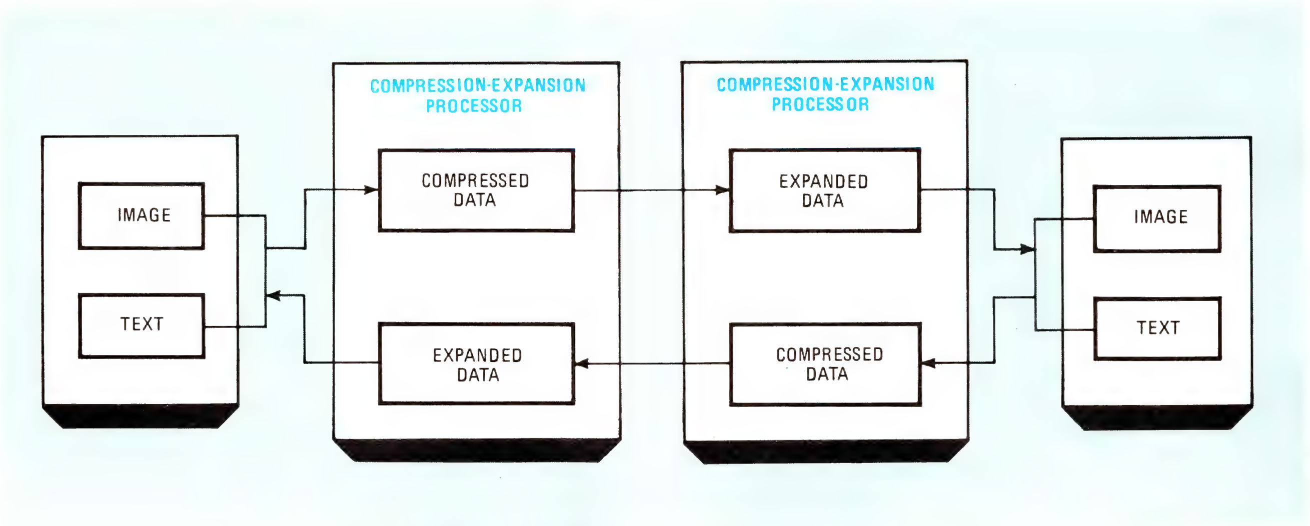
The integration of picture-element-based image processing into the more established character-based text-processing found in electronic information networks has quietly begun (Fig 1). With digital image formats, both image and text data can be entered, edited, and transmitted very effectively to other systems, both local and remote. This is possible for two reasons.

The first is that digital facsimile standards recently developed by the International Telegraph and Telephone Consultative Committee (see "Data compression and the CCITT groups 3 and 4 standards," p. 56) define highly effective two-tone compression and expansion procedures. This compression of the pixel-image data greatly reduces the memory space required for image storage and allows the image to be transmitted with far greater efficiency. Equally important, the incorporation in the system of an internationally accepted standard method of compression ensures that the compressed image data can be expanded transparently to its original form on an ever widening variety of equipment.

The second reason is that implementation of these techniques and standards has been incorporated within very large-scale integration single-chip microprocessor peripherals, such as Advanced Micro Devices Inc.'s Am7970 Compression-Expansion Processor, or CEP (see "What is the CEP?," p. 57). Such solutions will lower the cost of image processing because of volume production pricing. Because of these two developments, office equipment can readily combine pixel-based image-processing capabilities.

Integrated work stations

The basic ingredients of such systems are a high-resolution viewing screen, a keyboard for text and number inputs, a mouse, pen, or other manually operated input device, a healthy complement of mass and random-access storage, and a communications link to remotely located equipment as well as to neighboring work stations. Peripheral equipment might include a document scanner, a pixel-based printer, communications hardware, and some shared buffer memory. The basic operating modes of an integrated image-text work station will include:



1. Words and pictures. One compression-expansion processor (CEP) at each end of the system can either compress outgoing or expand incoming text and image data. Data can be transmitted for printing, display, and so on or can be archived in a mass-storage system.

- A character-oriented text-processing mode.
- A pixel-oriented facsimile or image-processing mode.
- An image-text mixed mode.

The character-oriented text-processing mode will be a straightforward evolution of the text and number processing available today. The facsimile mode will support station-to-station transmission of pixel-based images, thus incorporating the fax terminal within the work station. It also will go beyond paper-constrained fax technology to allow editing and storage of scanned documents and of work-station-generated images.

With an image-text mixed mode, fully integrated image and text processing can take place in at least two forms. In its simplest form, text and image portions of a document are contained in separate regions (windows) to be combined or overlaid electronically. Selective resolution conversion may be required at the terminal or printer to ensure that the sections maintain their correct physical relationship within the display medium.

A more complex mode would add optical character recognition (OCR) to support mixed processing of scanned-in image-text documents. Mixing OCR, to process text, with pixel-image compression, to process pictures, will allow storage of the text and image data in their most compressed form. Equally important, this will allow the text sections to be edited in text mode. This integrated image-text processor will eventually replace the traditional desktop text processor, because of its expanded capabilities and ease of use.

Integrated processing

The success of the integrated image-text work station will be based not only on the cost-effective compression provided by microprocessor peripherals but also on a variety of concurrent technologies both within and outside the work station. Image input, or conversion from hard copy to a pixel-based image, will be accomplished by lower cost and higher resolution scanners, such as the charge-coupled devices now in the marketplace. Image output for hard copy will be performed on pixel-oriented printers using laser, ink-jet, or related printer technologies, again with higher resolution available at decreasing cost. Cost-effective laser printers with resolutions of 300 pixels/in. are now available; 400 pixels/in. is not very far

Data compression and the CCITT groups 3 and 4 standards

Data compression encodes pixels to reduce the amount of redundant data. These redundancies can occur either horizontally, along the line (one-dimensional redundancies), or both horizontally and vertically, from line to line (two-dimensional redundancies). Since only the redundant image data is of interest, the image techniques standardized by the International Telegraph and Telephone Consultative Committee remove and regenerate only the redundancies, and so are image preserving.

Image-oriented systems such as work stations and facsimile equipment use scanning techniques in order to convert images to electronic data. This is usually done on a line-by-line basis in order to provide a continuous stream of pixels, which compose the image. The resulting image stream is then stored or transmitted, ultimately driving an image-reproduction or -display device. These image-output devices operate in a manner quite similar to the principles used in television, where 525 or 625 lines are used to reproduce images.

In image systems, clarity depends on the fineness (resolution) of the scan. The minimum vertical resolution that is required to reproduce a legible page of text is approximately 100 scan lines/in. Vertical resolutions of 200, 300, and 400 scan lines/in., however, are being used increasingly. A standard 8½-by-11-in. sheet of paper, if scanned at a resolution of 300 by 300 pixels/in., requires over 1 megabyte of storage. To transmit this data at 9,600 b/s without compression would take about 15 minutes. Clearly, this is not an efficient means of transmission.

In black and white picture systems, the maximum compression is very high—for certain images as much as 50:1. Thus, by using the data compression techniques outlined here, a standard-sized document could be transmitted in 30 seconds or less, depending on the resolution, compression method, image makeup, and so on.

In order to provide a common ground among the manufacturers of facsimile equipment, the CCITT developed international standards for facsimile manufacturers. Beyond their applicability to facsimile gear, these standards have resolved many of the issues concerning compression techniques in general and are leading the way toward the standardization of compression in office automation.

These standards are collectively known as Group 3, which specifies that equipment must be able to transmit an 8½-by-11-in. page in 1 minute or less, with a minimum vertical resolution of 3.85 lines/mm and a minimum horizontal resolution of 1,728 pixels. To accomplish this, the CCITT also specified the compression techniques that would be used to enhance the speed.

The standard compression scheme used in Group 3 systems is the modified Huffman code, a 1-d encoding of horizontal correlations among picture elements within a line. As an option, the Group 3 specification allows use of the 2-d modified relative element address designate (READ) code. This encoding technique takes advantage of pixel correlations in both the horizontal as well as the vertical dimensions.

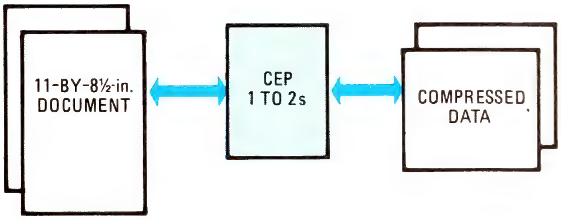
The CCITT is now making final its specifications for Group 4 equipment, which must be capable of high-speed transmission of data (at least 64 kb/s) and high resolution (between 240-by-240 and 400-by-400 pixels/in.), and must conform to the protocols defined in the Integrated Services Digital Network or Ethernet. This equipment is expected to operate over public packet-oriented data networks rather than the standard telephone lines used in earlier CCITT standards.

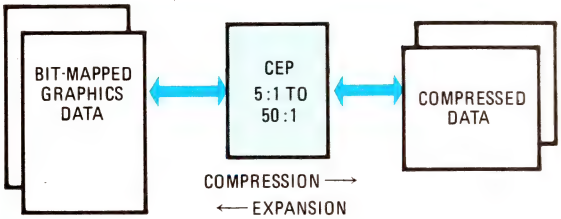
These Group 4 machines are expected to have store-and-forward capabilities for electronic mail and enhanced communications capabilities in order to be able to work with intelligent copiers and other work-station interfaces. Group 4 specifies the modified READ code as the standard data-compression method.

What is the CEP?

The Am7970 Compression-Expansion Processor (CEP) is a 68-pin, n-MOS very large-scale integrated circuit capable of CCITT-standard data compression and expansion of an 8½-by-11-in. document in 1 to 2 s (see top figure). This compression rate translates into an overall chip throughput of between 2 to 8 Mb/s at a 5-MHz clock rate. These high speeds result from a patented parallel-processing architecture, developed by American Micro Devices. In addition, the chip has high-speed, dual-bus, direct-memory-access capabilities.

The Am7970 is the first chip to implement data compression and expansion as well as the first to fully support a dual-bus architecture. Because of this architecture, the system can operate on uncompressed picture data and compressed coded data on separate buses, to facilitate the independent processing steps needed for each type of data. The CEP can, in fact, simultaneously expand and compress both text and image data, enabling it to operate in full-duplex mode.





Equally important, using standard data compression techniques, the Am7970 can achieve compression ratios as high as 50:1 (see bottom figure). This dramatically reduces system storage needs for image data and, at the same time, boosts effective transmission rates.

The Am7970 offers a wide variety of programmable options, including the ability to completely specify document paper width (up to 16,000 pixels) and top, left, and right margins. Document formatting ability in hardware is important for CCITT Group 4 equipment, since it facilitates the compression of windows of image data to be combined (overlaid) with text. The CEP is also flexible in either its one-dimensional (Group 3) or two-dimensional (groups 3 and 4) coding operation and supports multiple make-up codes, which are an extension of the CCITT T.4 and T.6 recommendations.

In 2-d operations, the CEP supports the specification of a programmable K parameter, which determines the length of each section to be coded two-dimensionally. With this programmable K parameter, document encoding or decoding can be adjusted to correspond to a system's transmission error rate. Finally, the CEP allows specifying options such as end-of-page, return-to-control, byte boundary, and so on.

Other features include status information to indicate the current state of the chip's operation and any errors that may have occurred, plus current and previous address registers to allow total specification of source and destination transfer locations, as well as to provide a history of the last transfer for system restart operations as needed. For ease of implementation, the CEP also has a standard microprocessor-compatible bus interface with control signals much like those found on the popular 8085, 8088, and 8086 microprocessors. For a small footprint, it is housed in a 68-pin leadless chip carrier, or pin grid array package.

The user can program the CEP for compression or expansion of single or multiple scan-lines. In transparent operation, transferring data without modification is possible, which is useful in buffer transfers across buses by the on-chip DMA controller. The CEP can also be programmed to duplicate or skip selected lines for the basic resolution conversion that might be needed to communicate with various generations of CCITT-compatible equipment.

Thus the CEP's versatility offers a wide variety of choices, utilizing the power and economy of CCITT-standard data compression that is critical in pixel manipulation or transmission. This is particularly true in applications requiring urgency, accuracy, and black and white graphics combined with text, including integrated work stations, facsimile systems, order entry in manufacturing, and signature verification for money transfers in banking.

TYPICAL COMPRESSION RATIOS

	Compression ratio (scanned data/compressed data)			
	Group 3		Group 4	
Pixels/in.	200 X 100	200 X 200	200 X 200	400 X 400
Test document	2-d	2-d (K = 4)	2-d (K = INF)	2-d (K = INF)
1	15.2	20.1	27.7	37.7
2	15.1	24.2	40.5	48.2
3	8.7	13.3	18.6	26.9
4	5.3	6.7	7.7	12.7
5	8.5	12.4	16.5	20.5
6	10.2	17.7	29.0	39.9
7	4.8	6.1	7.1	13.5
8	7.9	13.0	19.9	26.8
Average	9.5	14.2	20.9	28.3

Note: Compression ratios are highly dependent on the document.

in the future. Low-cost, small-footprint desktop laser printers are now being introduced.

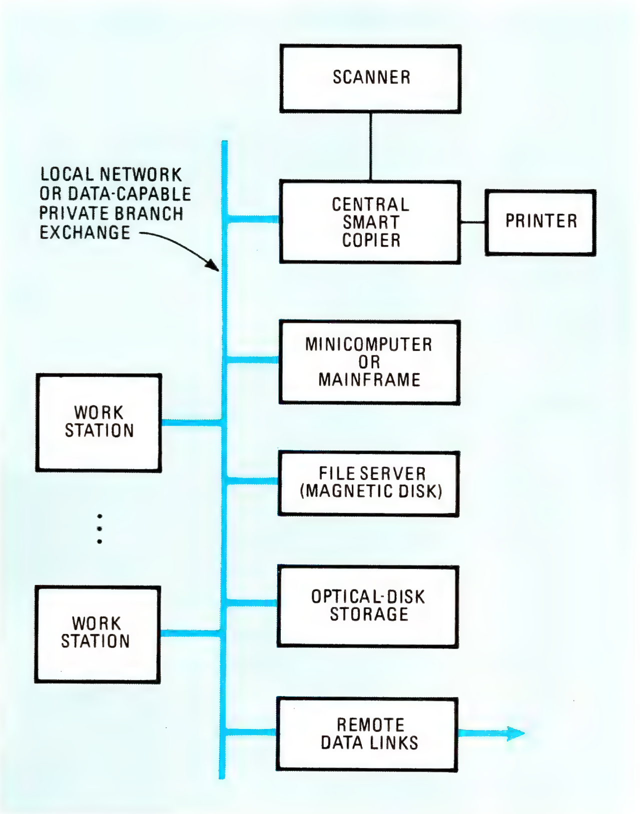
Image output to a screen will be supported by cathode ray tubes of varying sizes and resolutions depending on the application. For the high resolution needed in applications such as working on engineering documents, large-screen terminals are available today with a 300-by-150-pixel/in. resolution.

Thus, accelerating technology is increasing the feasibility of image storage. Even though compressed pixel image data needs considerably more memory space than character-based text data, this tends to be offset by increasing disk memory and associated reductions in cost per bit. Small 5¼-in. magnetic disk drives are beginning to reach the 100-megabyte range and write-once, read-mostly optical disks make gigabyte capacities available. Local networks and data-capable private branch exchanges will support fast, reliable intra-office communications.

Interoffice communications will be supported by dial-up and leased-line modems over voice lines, by digital packet-switching networks, and by digital circuit switching networks such as AT&T Co.'s Digital Data Service (DDS) and eventually the Integrated Services Digital Network (ISDN).

In digital packet switching, the data being transmitted is divided into units called packets, which are sent and received by switching equipment that ensures the data's receipt, storage, and delivery. Error controls for each packet ensure minimal transmission errors and high-quality transmission. The ISDN will handle voice and data (including facsimile) in a digital mode at PBX and public-network levels.

It is these processing, storage, and communication technologies that will work with the CCITT's compression-expansion standards to create widespread image-processing office automation systems (Fig. 2).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CENTRAL SMART COPIER
PRINTER
MINICOMPUTER OR MAINFRAME
WORK STATION
FILE SERVER (MAGNETIC DISK)
OPTICAL-DISK STORAGE
WORK STATION
REMOTE DATA LINKS

2. Networking. The image-text office network is becoming the target of many electronics industries, including chip making, telecommunications, computers, and peripherals. Rapidly changing technology in each area will contribute to the growth of these networks.

Image-processing applications

The integrated work station will move offices considerably closer to the paperless workplace. Pixel-oriented image processing will be incorporated into an increasing range of compatible equipment able to communicate over local and wide-area networks, thus eliminating most paper-intensive applications.

Images will be sent electronically to single individuals and wide distribution lists. Station-to-station electronic mail systems and broad-scale store-and-forward systems will transparently transmit image information.

Documents will be scanned and stored in central electronic file cabinets, making cross-indexing a simple task. A number of users will be able to retrieve the same documents with great ease.

Smart copiers based on lasers will render obsolete the existing dumb electrostatic drum machines. Since they will be able to transmit and receive data over local and long-distance networks, these machines will be a copier, printer, fax machine, and scanner rolled into one. Documents will be entered through the scanner or received in compressed form from another terminal. They will be reproduced precisely or will undergo some simple manipulations and enhancements within the copier. Original pages might be reduced so that two or more are combined on a single page.

The office automation equipment and functions just described will soon make possible text and two-tone image processing with the same ease and efficiency enjoyed by text processing today. In addition, extensions of the compression-expansion standards to include gray-scale and color-image processing will allow half-tone and color images to be similarly supported on integrated work stations within a few years.

Many groups are now working on techniques for image preserving gray-scale data compression and expansion—but no clearcut leader is emerging. The CCITT is working toward a gray-scale extension to their standards. A color compression standard, based on compression by color plane, is also under development.

The ultimate objective of office automation, the paperless office, is not yet a reality. But with internationally accepted black and white image data compression and expansion standards, and their implementation within VLSI chips such as the Am7970, integrated processing of most office documents is possible today. Final definition of gray-scale and color standards, and the VLSI chips to implement them, will soon allow the inclusion of all forms of documents, text, and image data within automated offices. ☐

John Landau is product marketing manager for Advanced Micro Devices Inc., Information Products Division, Austin, Texas. James Williamson is headquarters application engineer for AMD in Sunnyvale, Calif.

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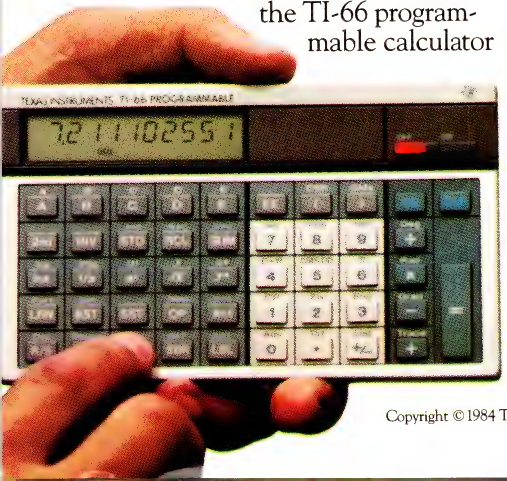

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BEEFED UP HP 150s TALK TO IBM PCs

Enhancements increase the Touchscreen's data storage capacity and provide five means of communicating with IBM PCs and mainframes

☐ *by Steve Zollo*

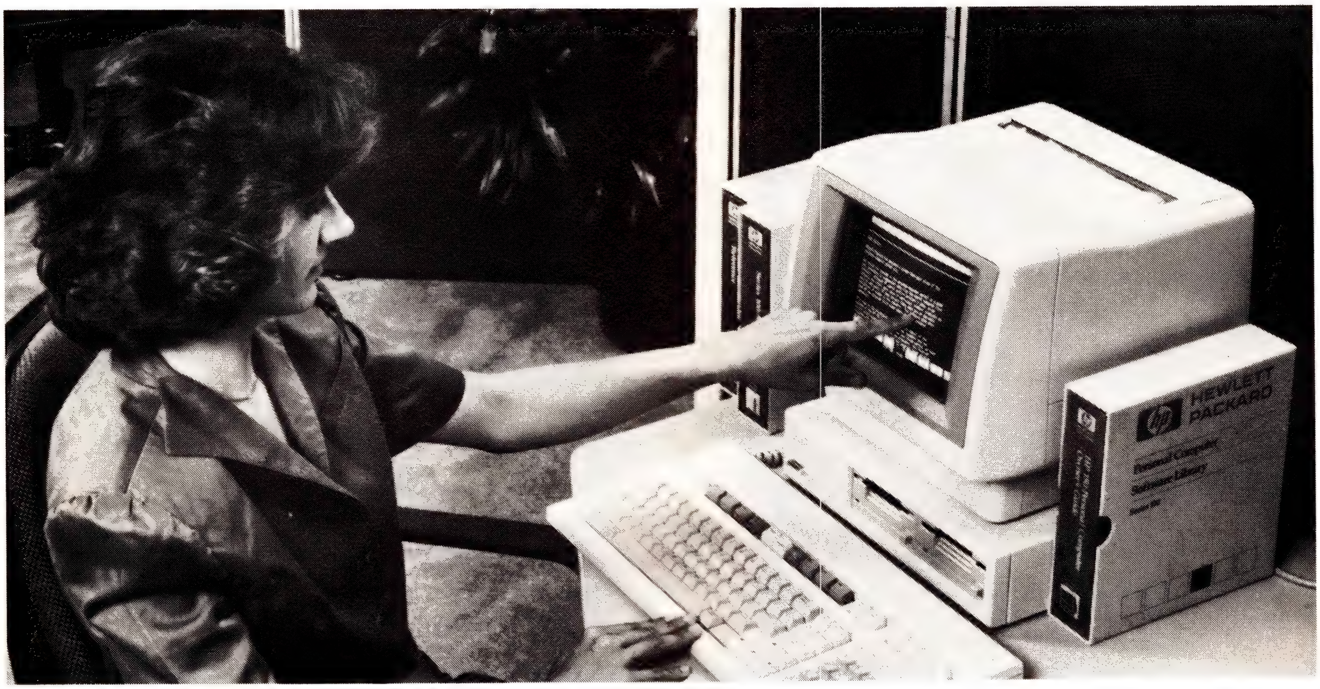
Bowing this week are two enhanced Hewlett-Packard Co. HP 150 Touchscreen personal computers with which users can share information and printers not only with other HP personal computers but with IBM Corp. Personal Computers and compatibles as well. Also available with the enhanced computers is a new disk drive, the HP 9125S, with which users can exchange data from 5¼-in. disks between IBM PCs and the Touchscreen computer.

With the communications capabilities provided through a local network made by 3Com Corp. of Mountain View, Calif., HP and IBM personal-computer users can send each other electronic mail. Local networking, which lets up to 50 IBM PCs and Touchscreen computers share peripherals, is one of five ways Touchscreen computers can communicate with IBM PCs.

In addition to the network and the 9125S disk drive, the other ways to communicate with IBM PCs include a file-transfer capability, by which users can move data among the Touchscreen, the PCs, and IBM mainframe computers; AdvanceLink, an enhanced version of HP's DSN/Link, with which Touchscreen computer users can transfer files containing data they want to share with IBM PC users; and the portable-desktop link, which enables Touchscreen computers and the IBM PC to share data with HP's Portable.

The Touchscreen computers have also been upgraded with disk drives that double their previous capacities. The HP 9122D dual floppy disk drive, used with the Touchscreen personal computer, has two double-sided 3½-in. disk drives providing a total of 1.4 megabytes of storage. The HP 9133D 15-megabyte Winchester disk drive, used with the the Touchscreen MAX, includes a double-sided 3½-in. floppy disk drive that contains 710-K bytes of storage.

Touchscreen MAX will also support the HP 9143D, a



15-megabyte stand-alone Winchester disk drive. This drive can be backed up in 8 min with the HP 9144A, a ¼-in. cartridge streaming-tape drive that sells for $3,500. The drive, which has a maximum sustained transfer rate of 2 megabytes/min, uses cartridges that hold either 16.7 or 67.1 megabytes.

In addition to these drives, both Touchscreen computers can make use of an optional memory card in order to make part of the Touchscreen's random-access memory act like a disk drive. By storing data on the electronic disk, as the company calls it, users will be able to run programs many times faster than on external disk-based systems.

The HP 9125S, which sells for $1,200, is a single 5¼-in. disk drive that gives the Touchscreen computer and Touchscreen MAX data-compatibility with the IBM PC through 5¼-in. disks. Connected by the HP Instrument Bus (IEEE-488) to the Touchscreen computers, the drive can read and write in IBM PC-DOS formats (releases 1.0, 1.1, 2.0, and 2.1). Thus, users can exchange 5¼-in. disks between the IBM PC and HP computers.

The HP 9125S also provides data exchange between other HP computer systems. With this drive, users of HP 3½-in. disk-based technical desktop computers can exchange disks with 5¼-in. disk-based desktop computers.

To be available this month, the Touchscreen personal computer sells for $3,495 and the Touchscreen MAX goes for $5,495.

Hewlett-Packard Co., Inquiries Manager, 1020 N.E. Circle Blvd.,
Corvallis, Ore. 97330. [Circle reader service number 338]

In-circuit tester detects data-timing errors

With the introduction of the series 730, in-circuit testers can now detect data-timing errors in chip. As a result, the company claims, chips that work but perform outside desired specifications can now be identified during the in-circuit test, greatly improving the yield at the next test station.

In addition, the series 730 testers have a hybrid architecture, dubbed Flexpoint, that allows the same flexible programming and easy debugging procedures found on nonmultiplexed systems while it maintains the same low cost per pin of typical multiplexed in-circuit testers.

Conventional in-circuit testers have clock generators that can only produce control signals to test whether the device under test works. But the 730 offers timing and formatting control of the device under test's input stimuli, and at pattern speeds of up to 10 MHz. By controlling the relationship of events (timing) and by setting each signal level (formatting), the programmer has maximum device timing control to achieve improved fault coverage.

The system's RAM-behind-the-pin architecture can be configured in one of two ways, depending on the type of device being tested. The 4-K-by-4 pin random-access memory configuration, used in conjunction with the sequence processor (called Accelerator), is designed to introduce algorithmic patterns to chips such as complex microprocessors and dynamic RAMs. The 16-K pin RAM configuration is designed to test custom and semicustom chips (such as gate arrays) where long, linear pattern depths are required.

The tester has diagnostic software that analyzes the initial diagnostic results and removes ambiguities that may arise from the fault message. This feature helps the user to identify the most likely causes of failure, which otherwise might be hard to find.

The 730 can accommodate up to 1,024 hybrid test points, allowing testing of digital, analog, and hybrid subassemblies. Each driver is dual-level, dual-family, and programmable over the range of ±6 V. Under program control, eight clocks and eight cycle times are available in real time. Formatting controls consists of nonreturn, return to one, and return to zero. In addition, the programmer can synchronize to an external clock or device under test.

Available 90 days after ordering, the 730 is priced starting at $150,000.

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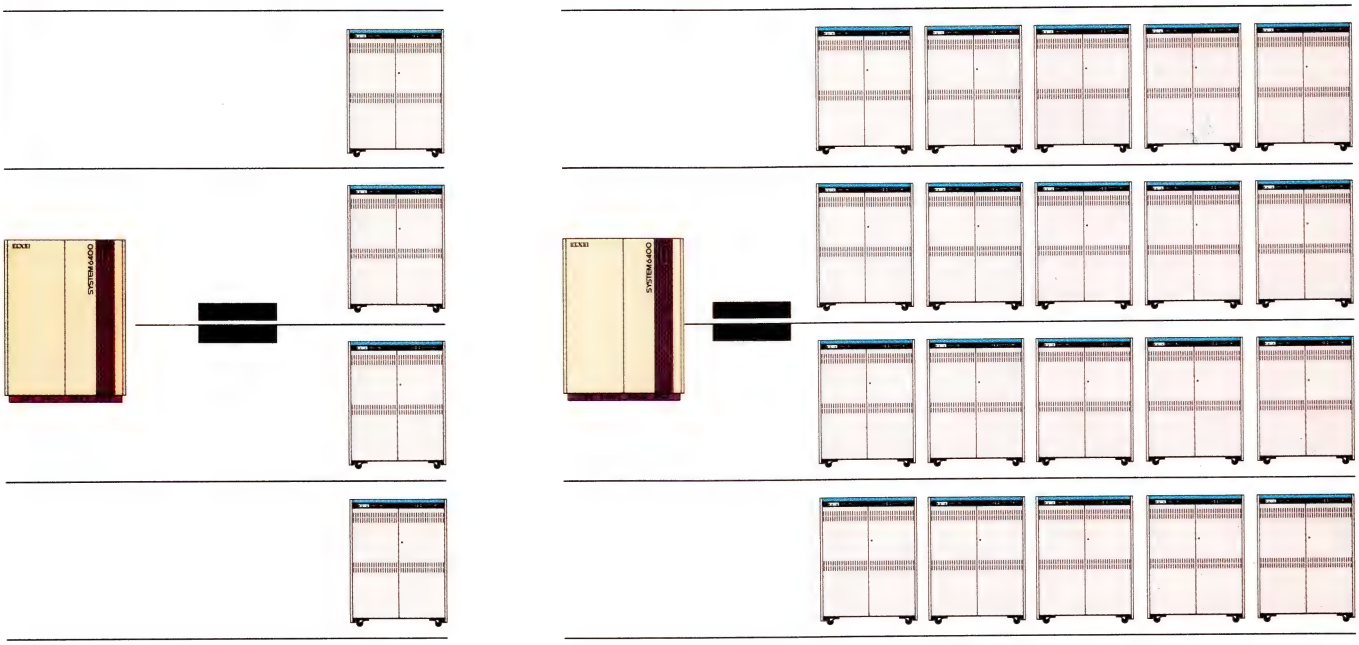

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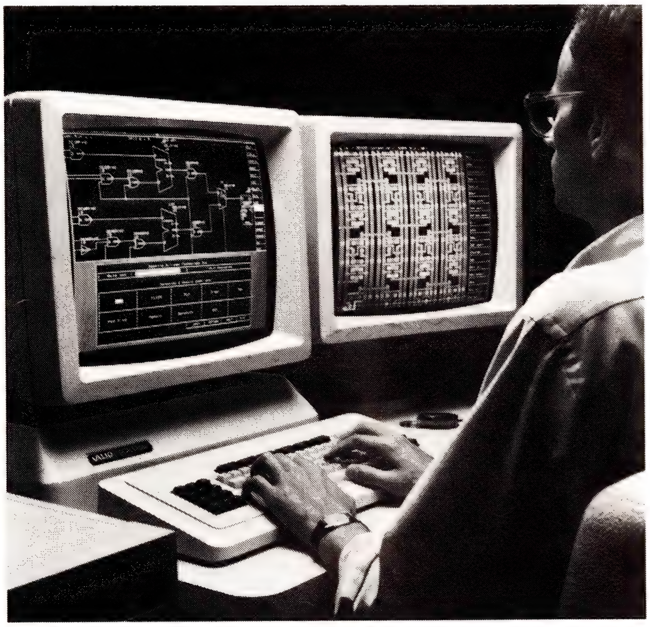
and implement their designs in full-custom ICs that approach hand-crafted custom chips in density and performance, the company says. All Scaldstar software runs under a version of Unix.

Silicon compiler designs are 50% to 70% smaller than comparable gate arrays, and they achieve 90% of the density and close to 100% of the performance of hand-crafted custom chips. The company says that with Scaldstar and the Concorde silicon compiler, chip designs do not take as long or cost as much as equivalent designs implemented in gate arrays.

Concorde can automatically generate sophisticated functions from high-level user input information. The user specifies functional descriptions and parametric options, and the compilers generate the function's physical implementation to the selected process design rule set. The resulting module may be automatically interconnected to input/output pads through the Concorde pad ring compiler, or it may be used as a building-block module together with other similarly constructed modules to create more complex chips.



When it becomes available in December, a Scaldstar equipped with the Concorde silicon compiler will sell for $100,000.

Valid Logic Systems Inc., 2820 Orchard Pkwy., San Jose, Calif. 95134. Phone (408) 945-9400 [Circle 382]

Multiplying converter is accurate to 1 arc-min

A four-quadrant digital-to-analog converter for industrial use multiplies by sine and cosine and offers up to 1 arc-minute accuracy and 16-bit resolution. Compatible with both 8- and 16-bit microprocessors, the HDSC2306 is housed in a ceramic 28-pin dual in-line package.

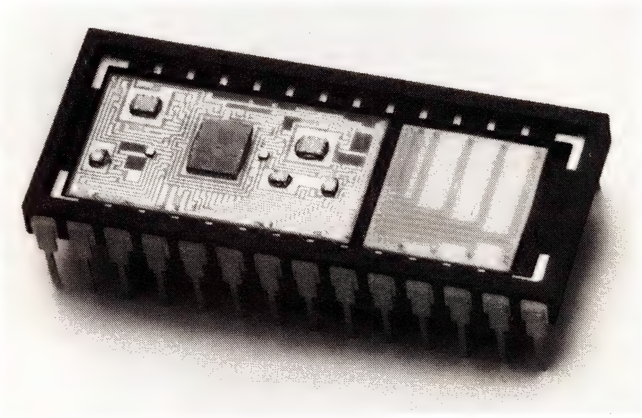
The 2306 is useful for applications requiring real-time multiplication of an input voltage by both the sine and the cosine of a digital input angle. Requiring only ±15 V power supplies and offering a radius accuracy to within 0.03%, the 2306 can be used for coordinate conversion, low-frequency oscillators, axis rotation, and digital-to-resolver (synchro) conversion, among others.

Other features of the 2306 include double-buffered inputs, buffered reference input, dc-coupled reference and outputs, pin-programmable gain, and compatibility with both TTL and CMOS levels.

The 2306 is available in versions with angular accuracies of 1, 2, 4, and 8 arc-min. These accuracies are guaranteed over the specified operating temperature range. The company claims the accuracies are achieved thanks to the use of buffer amplifier circuits (rather than special compensation circuits) to eliminate the effects of analog switch resistance.

Available in six weeks, the 2306 is priced starting at $180 each.

Natel Engineering Co., 4550 Runway St., Simi Valley, Calif. 93063. Phone (805) 581-3950 [Circle 383]



Low-cost assembly robot boasts easy user repair

Priced under $10,000, an articulating assembly robot has movements along five axes as well as automatic hand opening and closing. In addition, the 88-5 performs at speeds up to 20 in./s. The manufacturer stresses ease of installation and servicing by in-plant personnel as a plus for the purchaser.

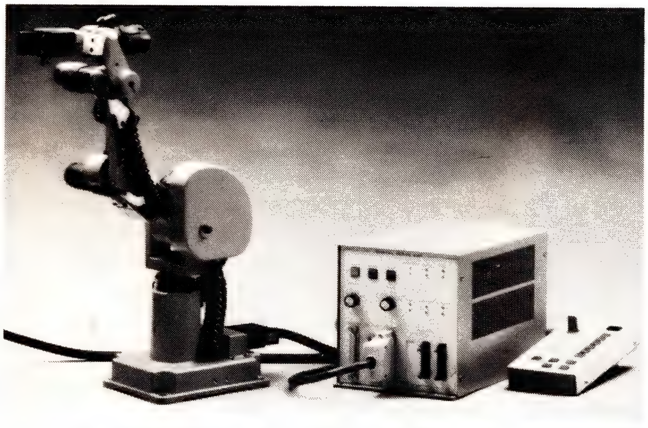
A digital servo amp offers a six-program storage capacity with each program having 78 set points, to provide a total of up to 468 set points. Digital optical encoders give repeat positional accuracy to ±0.004 in.

Interfacing with a host computer is possible if the user wishes to program positioning, loading, editing, and saving. A sequencer for input/output logic allows the 88-5 to operate through the user's system logic control.

The teach box, which is an option available in both standard and palletizing models, allows the operator to set positions without programming. Other options include various grippers and software that runs in Basic for personal computers.

The 88-5 is available from stock with a delivery time of up to four weeks. Final price will depend upon accessories, but the base price begins at $9,250.

Advanced Technical Products Inc., 955 W. River Pkwy., Grand Island, N.Y. 14072. Phone (716) 773-0972 [Circle 340]



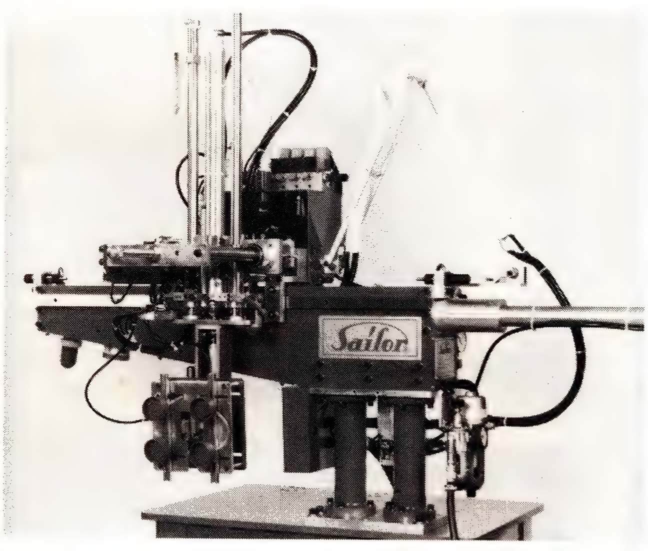
Parts-removal robot keeps workers out of danger area

Injection-molded parts from 50- to 100-ton molding machines can be removed by the completely automated model RZ-50 in 3 s, while keeping employees away from the hazardous mold-clamp area. Mounted on a stationary platen, the RZ-50 can unload on either side of the injection-molding machine.

A microprocessor controls the RZ-50's pneumatic drive. The standard end-of-arm tooling includes adjustable axes of motion and cylinder speeds. The air cylinders are nonlubricating, to eliminate the possibility of dripping oil on a finished part.

Molding-cycle consistency, the manufacturer says, is the RZ-50's strongest feature, resulting in higher product quality, increased output, lower labor costs, and less waste of materials.

For durability in industrial environments, all steel and aluminum components are zinc-plated, wiring is concealed, and raceways, guide rods, and guide-rod bushings are hardened. Fasteners are of industrial strength.



The base price of the RZ-50 is $18,000, and this price will increase according to user-specified end-of-arm tooling, options, and intended application. Delivery time is within 10 weeks.

Automated Assemblies Corp., 25 School St., Clinton, Mass. 01510. Phone (617) 368-8914 [Circle 342]

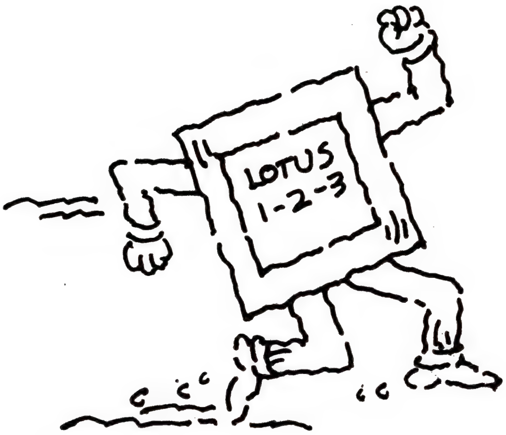
Industrial robot offers six axes of rotation, two speeds

Applications of the S-110R industrial robot range from arc welding, sealing, and finishing to materials-handling operations, in either standard or high-speed versions of the model. Three models of the S110R robot are available, two with six axes of motion and one with five axes. The six-axis standard-speed model handles payloads weighing up to 22 lb; the five- and six-axis high-speed models handle up to 11 lb.

The six-axis high-speed S-110R has θ axis (rotation) of 300° at 90°/s and comparable capabilities for waist and shoulder rotation, wrist yaw, arm roll, and wrist roll. Positioning repeatability is ±0.008 in. for all versions.

The S-110R is the first robot from this manufacturer that can be mounted either on the floor, on a wall, or in an inverted position. Command is through the R-model C controller, a widely used numerical control.

External memory has been enlarged to provide storage for up to 24,000 points. The software contains a scaling function for multipass welds and also mirror-imaging capabilities. The manufacturer has revised the teaching pendant for the controller to allow programming of most functions, including most arc-welding commands,



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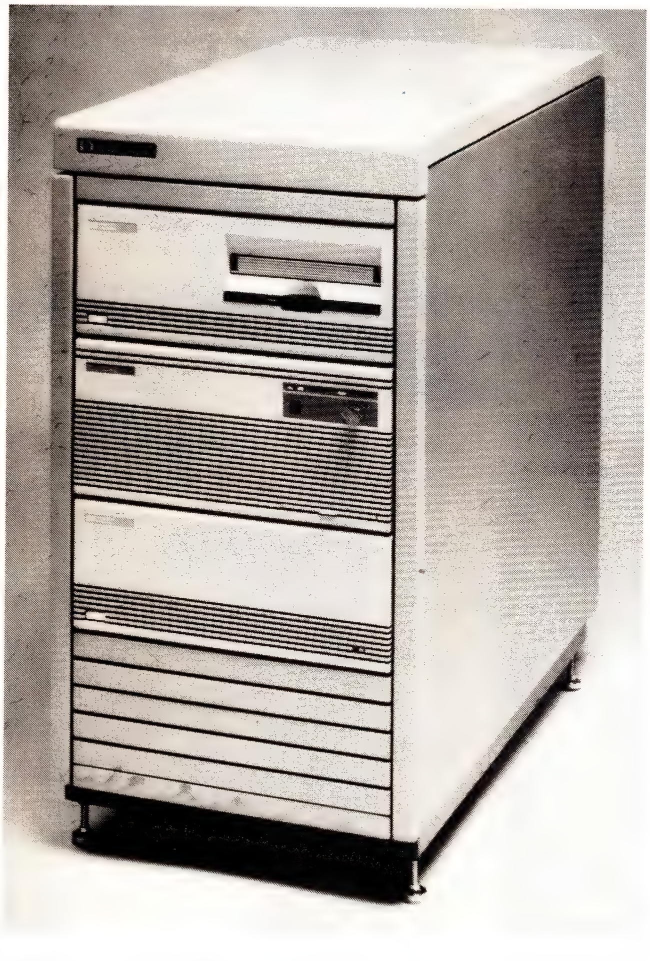
through the hand-held unit.

Pricing of the base robot varies according to software and hand tooling desired. The six-axis high-speed version sells for $47,500; the six-axis standard-speed version for $45,500; and the five-axis high-speed version for $42,500. Delivery, depending upon hand tooling, installation, and other variables, takes up to 16 weeks.

GMF Robotics Corp., Northfield Hills Corporate Center, 5600 New King St., Troy, Mich. 48098. Phone (313) 641-4242 [Circle 341]

28-user model fills HP 3000 line at low end



Capable of supporting up to 28 users and communicating with larger computers, the HP 3000 Series 37 office computer is no larger than a two-drawer file cabinet. At 6.14 by 12.8 by 15.75 in., the Series 37 can run all of the software available for use on the other members of the HP 3000 family, claims the company.

The Series 37 office-computer system is priced at $19,950; it includes 512-K bytes of main memory and a 55-megabyte disk drive, cartridge tape backup, systems console, and the Image data-base-management-system software. It can be expanded to up to 28 terminals, 2 megabytes of main memory, and 2,400 megabytes of disk-drive storage. Expansion to 2 megabytes of main memory is $6,500 and an additional 55-megabyte disk drive sells for $7,500. Delivery takes about eight weeks after receipt of order.

Hewlett-Packard Co., Inquiries Manager, 1820 Embarcadero Rd., Palo Alto, Calif. 94303 [Circle 384]

Quad line drivers have low power requirements

Two complementary-MOS telecommunications medium-scale integration quad drivers, the models MC143403 and MC143404, are said by the manufacturer to offer certain advantages over standard operational amplifier types. The MC143403 operates on 1.5 mA (typical) of current, while the MC143404 draws only 400 μA (typical). Both quad drivers operate over a single supply range of 4.75 to 12.6 V and provide an 800-kHz typical small-signal bandwidth.

The MC143403 and the MC143404 feature four drivers per package and a pinout compatible with the LM324 and the MC3403. The input impedance is over 12 MΩ, and input bias is a maximum of 10 nA. The input offset voltage is typically 10 mV, while the maximum specified is 30 mV.

Housed in 14-pin dual in-line packages, the MC143403 and MC143404 have a 1,000-piece price of $1.47 for plastic and $1.64 for ceramic parts. Volume sampling and production quantities are now available.

Motorola Inc., 3501 Ed Bluestein Blvd., Austin, Texas 78721. Phone (512) 928-6985 [Circle 343]

Versatile infrared chip has consumer, other uses

A 32-command infrared chip, the AY0492, has a range of applications that reaches from television sets and appliances to industrial controls, security systems, and computer keyboards.

The AY0492 features a low-cost oscillator that operates with a ceramic resonator (model AY0492A) or a remote-control network (model AY0492B). The chip, together with a keyboard, infrared diode, and an oscillator network, forms a complete remote-control transmitter. Packaged in an 18-pin dual in-line package, the AY0492 features pin-selectable data rates and a pulse mode. It is operated by a 9-V battery.

Qualification samples are available now, and production quantities will be available in October, with a four- to six-week delivery time. The AY0492 is priced at $1.15 each in quantities of 10,000.

General Instrument Corp., 600 W. John St., Hicksville, N.Y. 11802 Phone (516) 733-3107 Circle 344]

N-well manufacturing process increases chip's reliability

Three complementary-MOS programmable read-only memory chips derive their reliability and programmability from the n-well CMOS erasable PROM process, the manufacturer says. Each memory cell of the CY7C245, CY7C291, and the CY7C292 is erased and repro-

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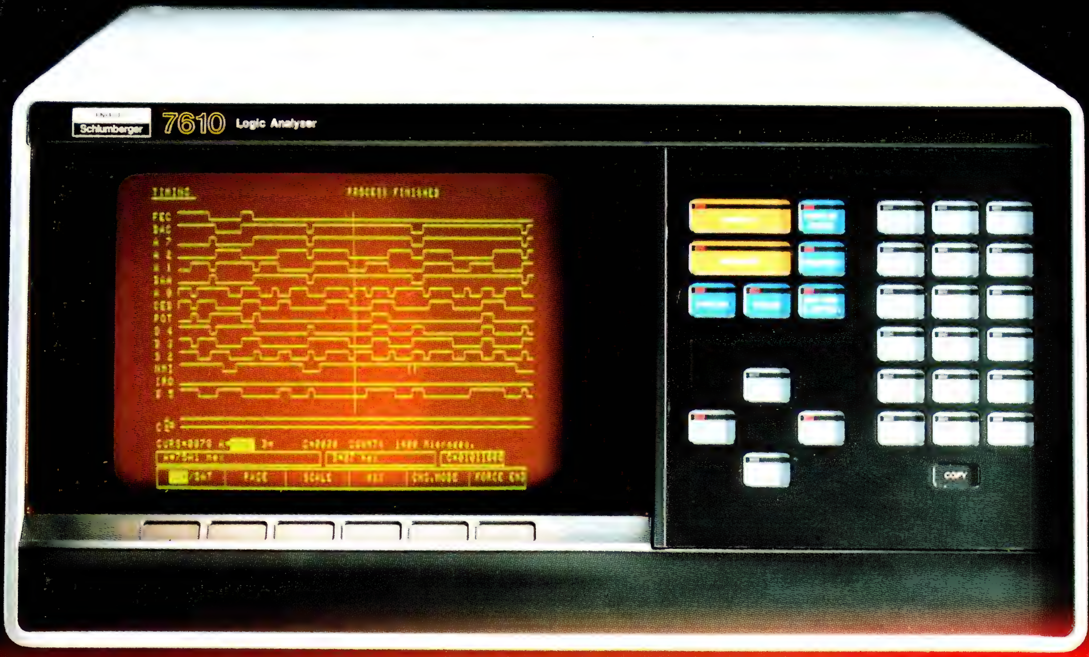

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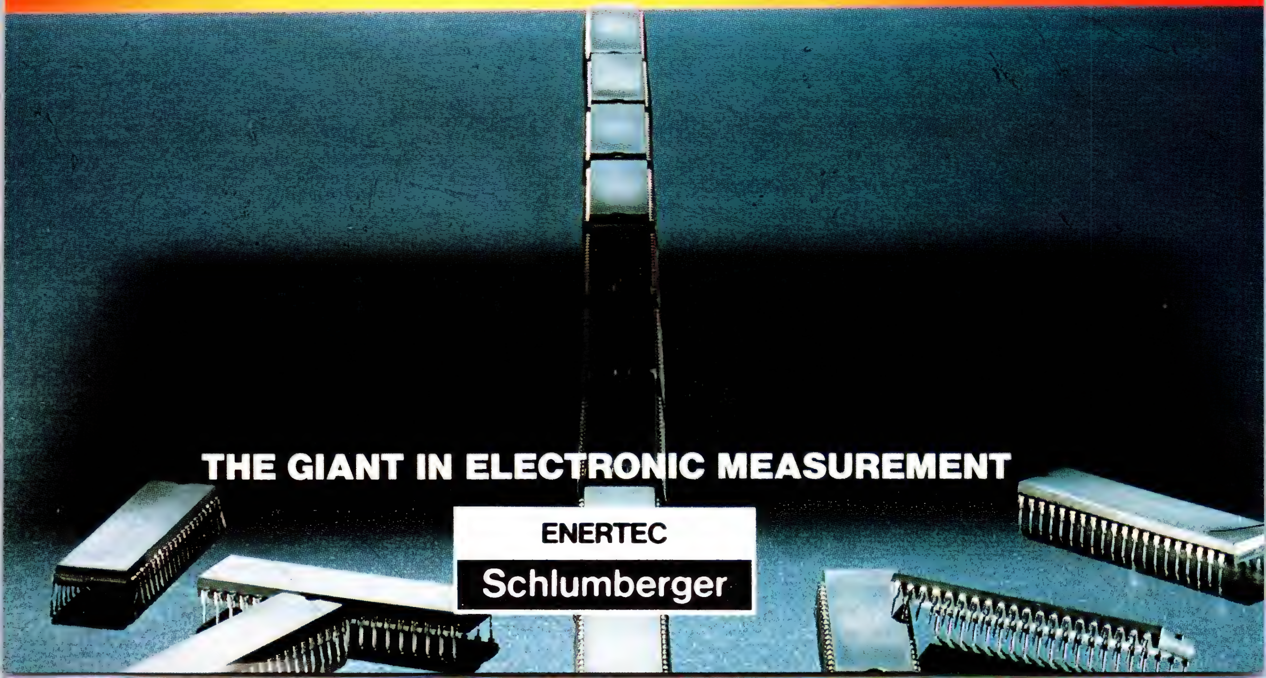

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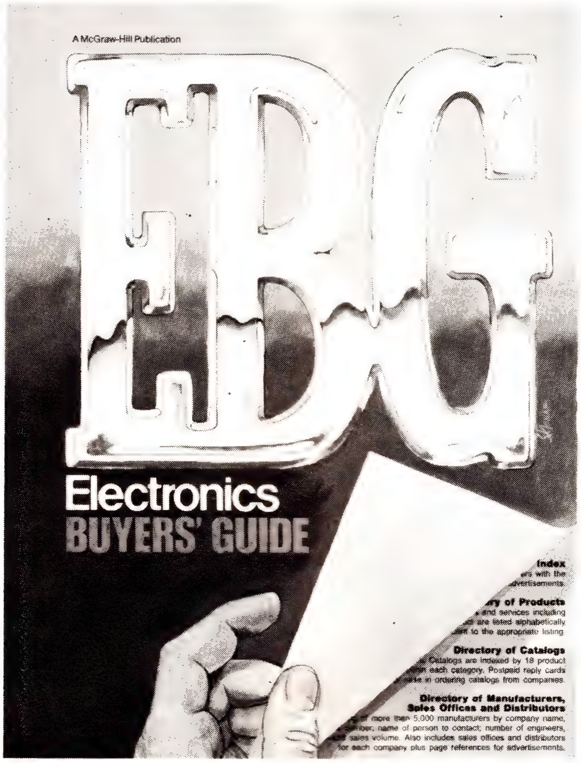
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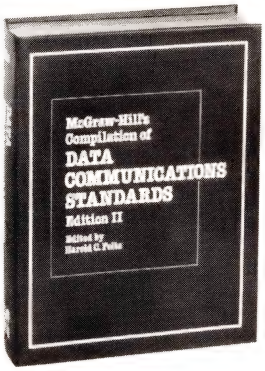

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grammed during manufacturing and before packaging, and is tested again following assembly. The CMOS EPROM process is also said to reduce power consumption of these chips by more than 50%.

The CY7C245 2-K-by-8-bit registered CMOS PROM is a second source to the Am27S45 bipolar PROM, providing 35-ns setup time with 15-ns clock-to-output times and 10% power-supply tolerances. It draws only 90 mA of current over the full temperature range of 0° to 70°C.

The CY7C291 and CY7C292 2-K-by-8-bit nonregistered CMOS PROMS provide 35-ns address access time with 20-ns chip-select access time over the 0°-to-70°C temperature range. Tolerances likewise are to within 10% on supply voltage with an 80-mA current draw.

The 50% reduction in power consumption makes it possible to package these chips in plastic, because reliability problems caused by excessive heat are eliminated, the company claims.

The CY7C245, CY7C291, and CY7C292 are available in 24-pin 0.3- and 0.6-in. ceramic and plastic dual in-line packages for the commercial temperature range, and in Cerdip for the military temperature range (–55° to +125°C).

The commercial-grade (35-ns) CY7C245 in a plastic dip is priced at $85.50 in quantities of 100. The military-grade (40-ns) CY7C245 in a Cerdip package is $120 in quantities of 100. Prices of the CY7C291 and CY7C292 are $27 and $77.25, respectively, in quantities of 100. All three chips are available immediately from stock.

Cypress Semiconductor Corp., 3901 N. First St., San Jose, Calif. 95134. Phone (408) 493-2600 [Circle 345]

Stimulus-response analyzer offers 256 to 1,024 channels

A modular, versatile instrument, the model RS-4004 20-MHz pattern generator-analyzer functions either as an automatic test-equipment system component or as a stand-alone benchtop instrument. The modular design permits user configuration from 256 to 1,024 channels, each with 1-K or 4-K of memory per channel. Access is either by menu for noncomplex applications or by Macro programming, which gives the user access to the RS-4004's complete word generation and analysis capability.

Applications include providing timing signals for charge-coupled devices, simulating complex logic patterns for very large-scale integration or very high-speed integrated circuit characterization, and phased signal generation for magnetic media research.

Pattern generation at 20 MHz can be accomplished in either the word-generator mode or the timing-simulator mode. The user may create multiple tables of parallel or serial data, and send out each table a specified number of times.

The list price for the basic RS-4004 configuration is $21,500, and optional cards range from $2,700 to $6,030. Delivery takes up to 12 weeks after ordering.

Interface Technology, 150 E. Arrow Hwy., San Dimas, Calif. 91773. Phone (714) 592-2971 [Circle 347]

Spectrum analyzer covers 0- to 100-MHz frequencies

Fast-Fourier-transform analysis now reaches into the megahertz frequency range with the model 3500SA200 spectrum analyzer. Resolution is to within 0.2 MHz, and finer frequency resolution can be achieved if frequency coverage is reduced. Fast transients are most readily characterized in this range, a desirable capability in the analysis of switching impulses, electrostatic discharges, and signals encountered in electromagnetic-pulse testing.

The model 3500SA200 calculates spectra of single transients, averaged waveforms, and periodic signals. Frequency spectra and digitized waveforms can be displayed simultaneously.

Keypad or light-pen operations can control signal acquisition as well as horizontal and vertical display parameters. Four 22-character lines of user annotation may be merged with any display, and a learn mode stores

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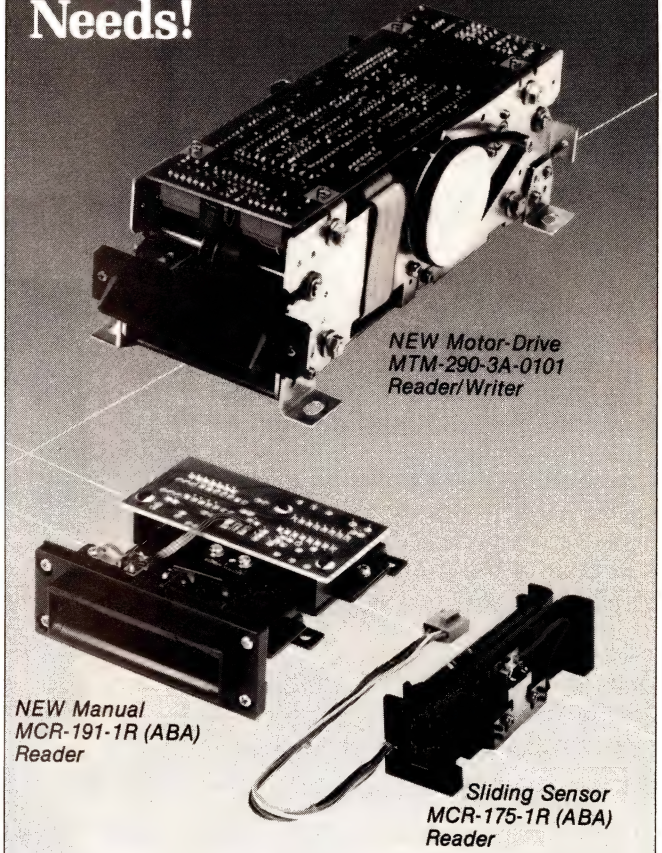

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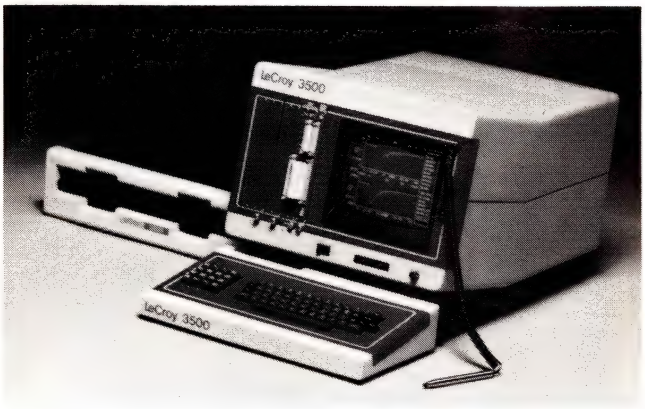


operating commands. The unit incorporates a microprocessor that operates under CP/M and supports software written in Fortran by the user. An IEEE-488 interface is available as an option, and the system has a dual floppy disk drive.

Delivery of the model 3500SA200 will be made in 30 days. The price of the system is $27,900.

LeCroy Research Systems Corp., 700 S. Main St., Spring Valley, N.Y. 10977. Phone (914) 425-2000 [Circle 346]

Multitasking kernel offered for IBM Personal Computers

A real-time multitasking kernel that the manufacturer says offers features not available in MS-DOS or PC-DOS, OSRT-PC supports all functions needed for process management, dynamic control of interrupts, memory allocation, and processor-to-processor communications.

OSRT-PC is offered to original-equipment manufacturers in source-code form, so that they may implement their own proprietary software for IBM Corp. Personal Computers and PC look-alikes. Features of PC-DOS 1.X and PC-DOS 2.X are retained.

Depending on the features utilized, OSRT-PC requires only 10-K to 12-K bytes of memory. OSRT-PC is written in the C programming language and is available with the small- or large-memory model. It can be linked with applications programs and run as a single task under DOS.

Applications set forth by the manufacturer include laboratory-instrument and industrial controls, telecommunications, and multiuser computer networks.

Available from stock, OSRT-PC sells for $9,600 for unlimited binary machine license.

The Destek Group, 830 E. Evelyn Ave., Sunnyvale, Calif. 94086. Phone (408) 737-7211 [Circle 349]

Software kit for Unix has C and Pascal compilers

Developed at the Free University of Amsterdam, the Amsterdam Compiler Kit is a package of C and Pascal compilers and assemblers for a number of host and target machines. It consists of eight components: the preprocessor, the front end, peephole and global optimizers, the back end, the target-machine optimizer, the universal assembler, and the utility package.

The kit also has a collection of programs designed to simplify the task of producing portable compilers and interpreters for micro- and minicomputers. It contains the complete sources of all programs (a source C compiler or Unix license is required) plus comprehensive internal documentation.

The Amsterdam Compiler Kit compiles Pascal and C programs on Unix 68000, 8086, VAX, and PDP-11 and can produce code for any of these machines. Cross-assemblers are also provided for the 8080, Z80, Z8000, 6800, 6809, 68000, 6502, and PDP-11. Cross-interpreters are included for testing.

The full system in source sells for $9,950. The price for educational institutions is $995. Selected binaries sell for $4,500. The kit is available now.

UniPress Software Inc., 2025 Lincoln Hwy., Suite 312, Edison, N.J. 08817. Phone (201) 985-8000 [Circle 350]

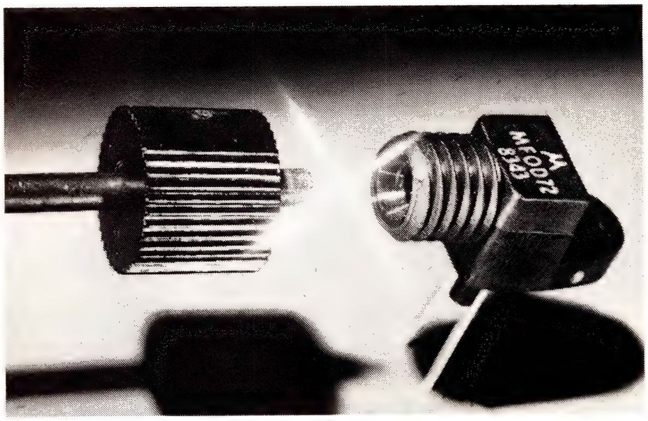
Fiber-optic system comes in three detector configurations

A low- to medium-frequency fiber-optic system is targeted at the low-cost, high-volume automotive, industrial, and appliance markets. Available in three detector configurations, the Fiber Optics Low Cost System (FLCS) package includes all necessary components and requires no special tools or knowledge of fiber optics to assemble, the company says.

The gallium aluminum arsenide infrared emitter chip has a minimum electrical bandwidth of 10 MHz at a wavelength of 820 nm, considered by the manufacturer to be the best match of the propagation characteristics of GaAlAs, silicon detectors, and plastic fiber for maximum signal transmission.

Thanks to the detector configurations—very high-gain photodarlington, standard phototransistor, and very fast p-i-n photodiode—the user can tailor a system to any of various applications. A 10-m length of 1,000-μm core cable is also available for use with the FLCS package.

In quantities from 100 to 999, component prices are as follows: 820-nm infrared emitter (MFOE71), $1.30; p-i-n diode detector (MFOD71), $0.98; transistor detector (MFOD72), $0.87; photodarlington detector (MFOD73),



$0.98; and 10 m of 1,000-μm fiber-optic cable (MFOA11), $12.50. Delivery takes up to 12 weeks.

Motorola Semiconductor Products Inc., 3501 Ed Bluestein Blvd., Austin, Texas 78721. Phone (602) 244-6786 [Circle 352]

Wang brings its computers into fiber-optic network

The Wang 7500T series of information-processing systems as well as the company's office-automation systems can now be joined by the FO-MC, a fiber-optic converter that marks the changeover from copper-based transmission to a fiber-based serial data link.

The freestanding FO-MC has its own embedded power supply. It is offered in two models, depending on which of the company's systems is already in operation at the user's location, and it can also be used to connect Tempest-accredited systems to non-Tempest systems in a mixed configuration.

The manufacturer cites data integrity and data security as the FO-MC's principal benefits. Electromagnetic and radio-frequency interference are eliminated, as are grounding problems.

Data links of up to 7,000 ft from computer to peripheral are claimed, compared with the 2,000-ft limitation with the same manufacturer's copper-based coaxial cable. Master-to-master connections can also be made. No modification of the controller or the peripheral equipment is necessary to make the changeover.

The FO-MC-1T Tempest model sells for $750, and the FO-MC-1S commercial model sells for $700. Both will be available in October. Cabling specifications and office-grade optical cable will be available from the company.

Wang Laboratories Inc., 1 Industrial Ave., Lowell, Mass. 01851. Phone (617) 459-5000 [Circle 353]

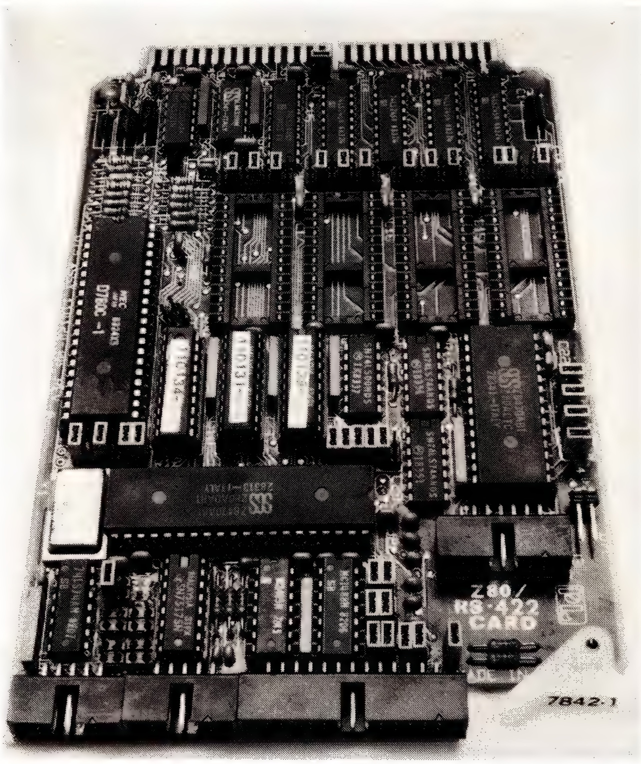
Z80A-based serial cards have multidrop capability

Two independent serial data-communications channels with multidrop capability are available on a Z80A-based card that provides either RS-422 or RS-232-C interface levels, depending on the channel selected.

The 7842 (pictured) offers cable lengths up to 4,000 ft, high noise immunity, and data transmit and receive rates up to 90 kilobaud over a distance of 4,000 ft—all desirable characteristics for both process-control and data-acquisition applications. Because of the dual-channel feature, the user can dedicate one channel either for long-distance or network use and the other for an RS-232-C interface.

The 7842 has 128-K bytes of on-board memory and accepts all combinations of 28-pin-compatible erasable programmable read-only or random-access memory, as specified by the Joint Electron Device Engineering Council.

The same manufacturer also produces the 7712 dynamic RAM card, which features memory expansion from 64-K to 512-K bytes with parity and automatic, transparent on-board refresh circuitry. The card is available in densities of 64-K or 128-K bytes, populated with 64-K-by-1-bit DRAMs, and of 256-K or 512-K bytes, with 256-K-by-1-bit DRAMs.



The 7842 central-processing-unit card is available now at a unit price of $425. The 7712 (512-K-byte) DRAM card will be available soon and will be priced as follows: 64-K-byte card, $490; 128-K-byte, $640; 256-K-byte, $1,050; 512-K-byte, $1,750.

Pro-Log Corp., 2411 Garden Rd., Monterey, Calif. 93940. Phone (408) 372-4593 [Circle 355]

PDP-11-compatible system resides on a single board

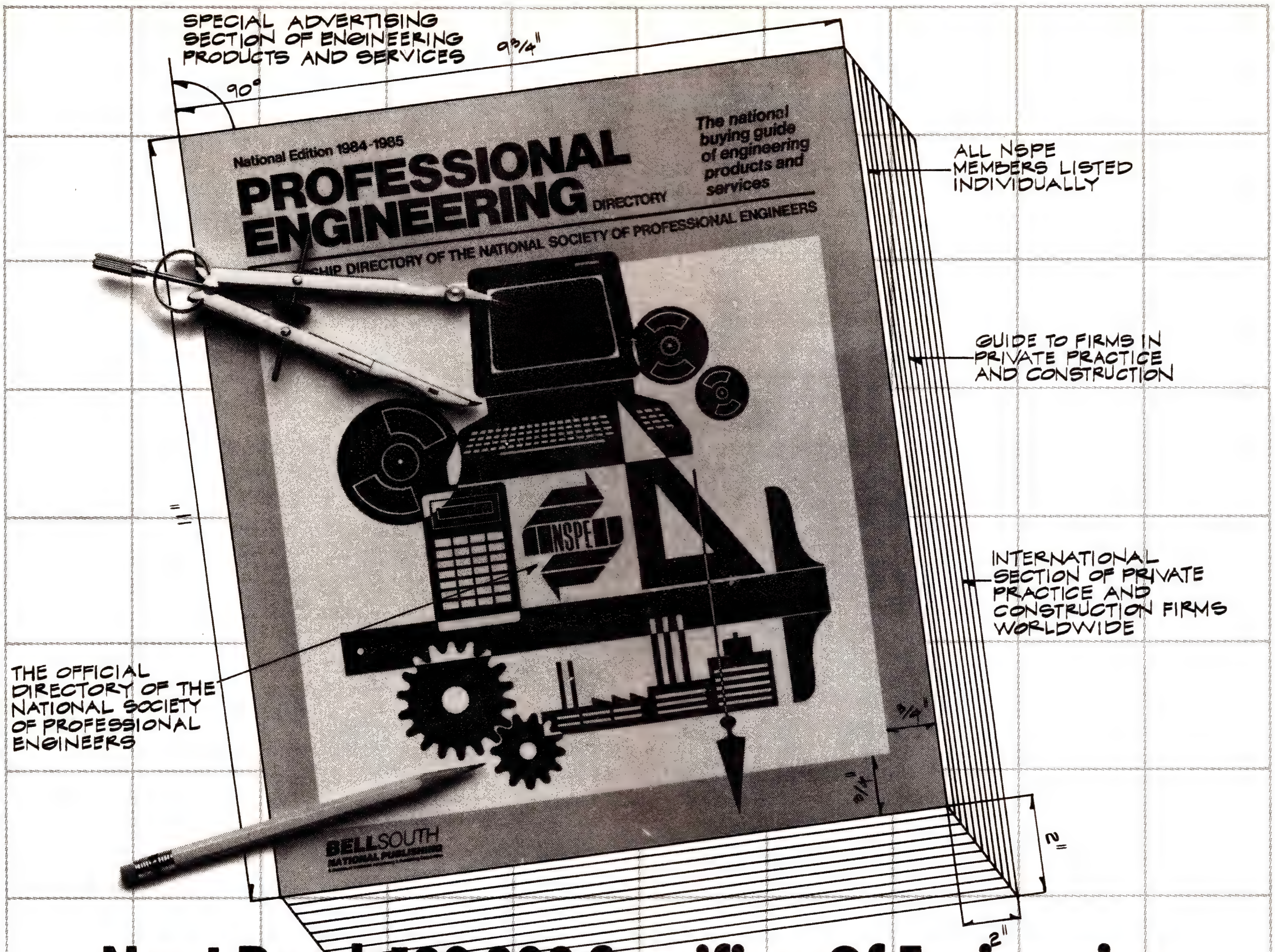
A full-function system based on the J11 16-bit chip, the Cobra/16, is PDP/11-compatible and is packaged three ways for original-equipment manufacturers, systems integrators, and end users.

For the OEM, the Cobra/16 will be available as a board-level product. The systems integrator may choose a freestanding, desktop, or rack-mount chassis unit with power and cooling for integration of peripherals. End users will be offered a custom-configured system.

The Cobra/16 module will include a central processing unit with hardware floating point, 1 megabyte of parity random-access memory, Winchester disk and streaming tape controllers, and a 32-port serial multiplexer on a single printed-circuit board.

The Cobra/16 will run standard Digital Equipment Corp. software as well as TSX, TSX-Plus, Unix, and Mumps. It possesses 16-K bytes of user-programmable read-only memory.

Available at the end of the fourth quarter, the Co-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General Robotics Corp., 57 N. Main St., Hartford, Wis. 53027.
Phone (414) 673-6800 [Circle 354]

One-inch display monitor has high-quality resolution

A miniature cathode-ray tube monitor that measures only 1 in. diagonally was developed for weapons sighting in tanks, but the quality of its resolution makes the unit desirable for nonmilitary applications such as phototypesetting and visual assistance during surgery, the manufacturer says.

The unit scans 525 interlaced lines, using standard RS-330 composite video input. The CRT can resolve up to 800 active lines per raster height.

Two models are available. The MHR-1100 produces 100 footlamberts (or approximately 32 footcandles) of luminance with a 20-W, 15-V power supply. The MHR-1010, a portable, 10-footlambert version, runs on 3 W of power from a battery.

The monitor consists of the display and a magnetic deflection coil encapsulated in silicone rubber, plus four printed-circuit boards that process video signals and provide deflection and all necessary power. The aluminum case measures 2.6 by 2.6 by 7 in.

The manufacturer will custom build the 1-in. monitors at prices that vary with customer specifications and quantity. Delivery will take up to six weeks.

Westinghouse Electric Corp., Industrial and Government Tube Division, Westinghouse Circle, Horseheads, N.Y. 14845.
Phone (607) 796-3350 [Circle 357]

Flat square CRT screens enhance data, graphic display

Three high-resolution tubes, available with standard options for screen phosphor, antiglare surface treatment, and glass transmission, are designed for enhanced data and graphics display. The enhancement is due to the flat square (FS) screen curvature radius of 1,200 mm, about twice the curvature radius usually available on cathode-ray tubes, the screen's manufacturer says.

The flat-faced tube has squared corners with straighter-than-usual edge profiles, which produce an image area with little distortion or surface reflection. This is particularly important in monitor applications where data covers the whole screen and the viewer is close to the screen.

The tubes come in 12- and 14-in. 90° (square-cornered) models and in a 15-in. 110° version. Provisional model numbers are V64A31-XP, V9A34-XP, and V48A-XP, respectively.

Development samples are expected to be ready to ship during this quarter. Prices were not available at publication time.

Philips ECG, 700 N. Pratt St., Ottawa, Ohio 45875 [Circle 358]
Philips Elcoma Division, P.O. Box 523, 5600AM Eindhoven, the Netherlands [Circle 385]

Lamps attach to boards with simplified system

A line of low-wattage miniature lamps can mount directly to a printed-circuit board with a quarter-turn locking system. Called Neo-Wedge, the line is suitable for a variety of applications, especially in the automotive industry.

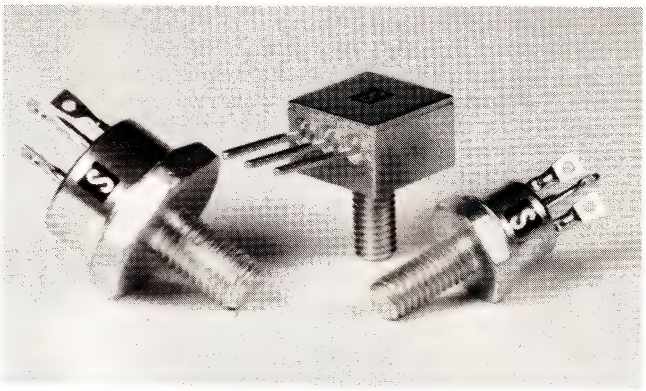
The lamp's design permits a positive, secure contact because the entire unit is inserted into a pc board and rotated a quarter turn, eliminating other steps. Replacement can be handled without damaging the board. The board-mount system is available in a variety of socket sizes with a BQ012 base and a number of integral bulbs.

Rated from 5 to 48 V, the units sell for as low as 21¢ in 1,000-unit quantities. Delivery is from stock.

JKL Components Corp., 13343 Paxton St., Pacoima, Calif. 91331.
Phone (818) 896-0019 [Circle 359]

Fast-switching power FETs suit high-temperature uses

A series of MIL-standard fast-switching power MOS field-effect transistors meets high-temperature requirements and features hexagonal geometry, voltage (drain to source) to 450 V, and drain currents to 10 A. The series, designated SwitchMos, is offered in isolated packaging in TO-61/I, TO-111/I, and TO-228 AA cases, and in stan-



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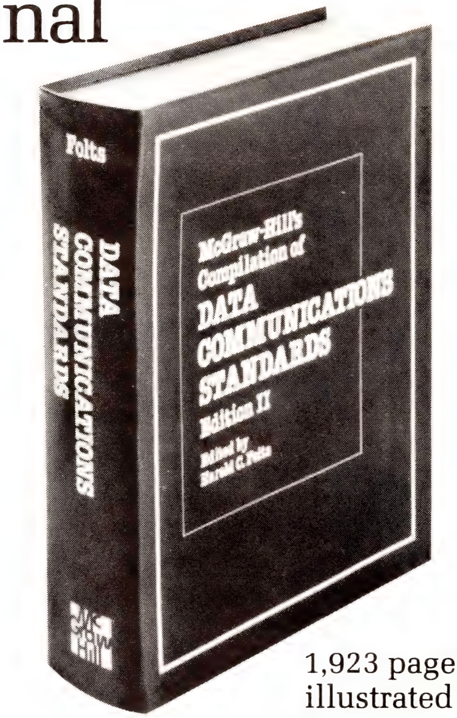
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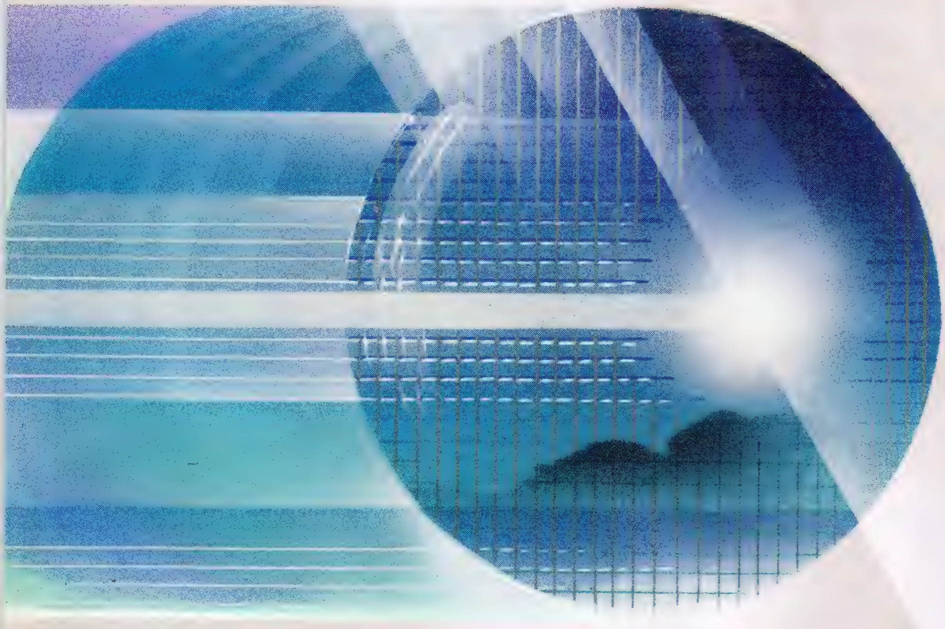
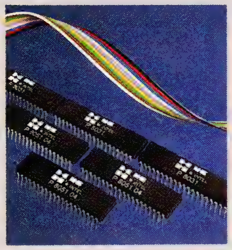


The choice of innovation thru technology

8051: An industry standard gears up a speed

MHS is completing its line of 8051/12 MHz microcontrollers with a 15 MHz model.

You must surely be familiar with the 8051. This high-performance circuit is an 8-bit microcontroller using HMOS technology.



For the first time, a 60,000 transistor VLSI circuit is being mass-produced to satisfy a worldwide demand. This microcontroller is a universal product used in most of all compact integrated systems.

3 more MHz means processing 25% more data.

Offered up until now at 12 MHz, the new model developed by MHS engineers provides even higher speed. Operating at 15 MHz, your systems will now be able to process 25% more data. In the fields of telecommunications, robotics, and industrial or military control systems, this additional performance combined with the 8051's recognized power and reliability, represents a major advantage.

8051/31: Immediate availability of a complete product range.

Production expertise is at the core of MHS's industrial strategy. This complete range, available in both plastic and ceramic packages in commercial and military versions, has been in mass-production for the last year at our Nantes plant. It is permanently available for users as a result of the regular and programmed increase in our production capacity. MHS is perfecting a standard, already highly sophisticated product and mass-producing a whole line of circuits in spite of the demand created. Thereby proving that it has well and truly become your main European source of performances.

8031/51		*Temperature*	*Packaging*
12 MHz	*Commercial*	*0 to + 70 DEG C*	*Plastic / Cerdip*
	Industrial	*− 40 to + 85 DEG C*	*Plastic / Cerdip*
	Automotive	*− 40 to + 110 DEG C*	*Plastic / Cerdip*
	Military	*− 55 to + 125 DEG C*	*Cerdip*
15 MHz	*Commercial*	*0 to + 70 DEG C*	*Plastic / Cerdip*
	Industrial	*− 40 to + 85 DEG C*	*Cerdip*

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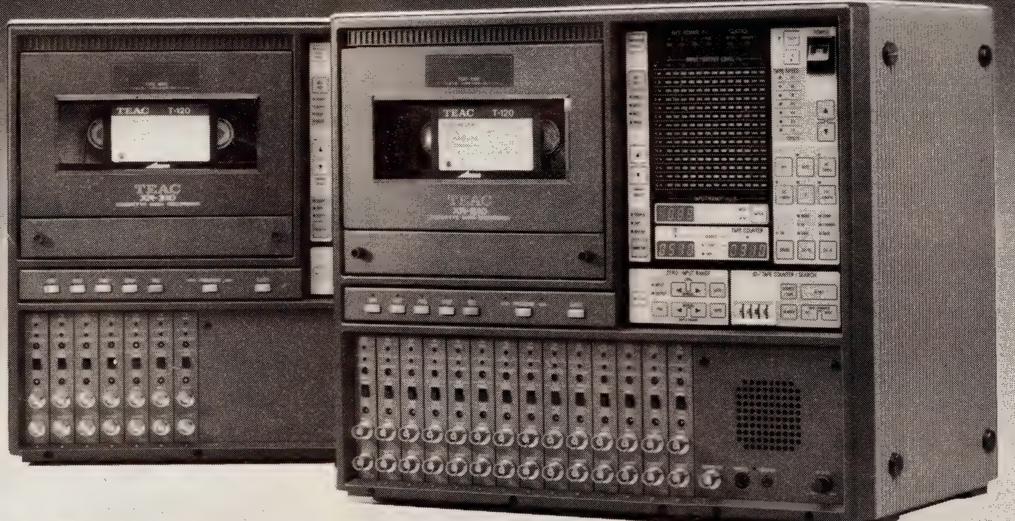
■Computer control using three microprocessors. ■Auto Program Loading function sets pre-record conditions. ■Centralized control panel with flat-panel switches. ■One-touch Self-Check function. ■Bar-graph type LED level meters. ■Optional GP-IB interface.



XR-30/50/70

Multi-speed, multi-channel capability with easy portability.

These three portable data recorders provide the multitrack capabilities and performance of open reel recorders with the convenience of cassette recorders. They have four selectable speeds with 8, 15, and 22 channels, respectively, and use 1/2-inch videocassette tape.

■Wide-bandwidth FM recording system standard, DR option available on XR-30 and XR-50. ■Two-way (AC/DC) power supply capability with optional DC power supply unit. ■Independent rec/reproduce heads for tape/source monitoring. ■Tape servo and noise compensation channels.

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GUARANTEE: UNIX System V and the 3B systems offer OEM and VAR's truly exceptional capabilities in meeting users' needs. But even more, Olivetti and AT&T pledge themselves to continue the upward compatibility of the UNIX System V, thus protecting software investments.

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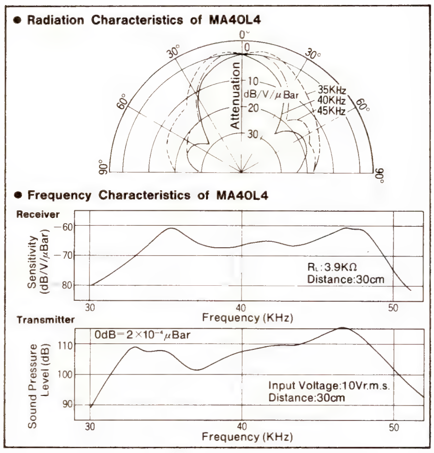
now presents two types of ultrasonic sensors, including mo
MA40L4 covering a maximum of 40KHz and model MA23L3 w
a maximum of 23KHz, which will surely help promote securi

[The MA40L4: Unsurpassed range and sensitivity]

The wide-band type ultrasonic sensor, MA40L4, detects intruders by covering an extremely wide range of frequencies, from 35KHz to 47KHz. It features the most stable damping coefficient, 35KHz to 47KHz, and it also has the widest operating range and is fully resistant to moisture, vibration, shock, and extreme temperatures in any environment.



● Radiation Characteristics of MA40L4

● Frequency Characteristics of MA40L4

[MURATA provides circuit design technology using multipurpose MA40

The MA40L4 not only detects intruders but also functions as an automo
back-up sensor to warn the driver of possible rear-end collisions and a
automatic focus sensor in many modern cameras. In addition to a cor
ete line of sensor products, MURATA also provides clients with cir
design technology including the required custom specifications. A hy
IC amplifier is also provided.

■CHARACTERISTICS

● Electro-Acoustic Characteristics

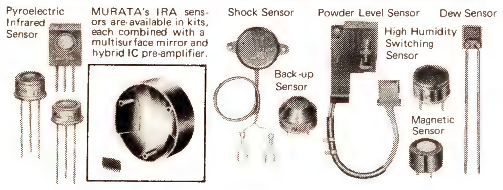
Nominal Frequency : 40kHz
Sensitivity : -73dB/V/μBar min.
Band Width : -73dB/VμBar min. at35～45KHz
Capacitance : 1400pF
Insulation Resistance : 100MΩ min.
Max. Input Voltage : 20Vr.m.s.

● Environmental Characteristics

Temperature Characteristics : Variation of sensitivity is within 10dB at -20° to 60°C
Humidity Test : Variation of sensitivity is within 3dB after 100 hrs. in 90 to 95% RH at 40°C test.
Shock Test : Variation of sensitivity is within 3dB after shock test; Sine 100G (6m sec) 9 times (3 times per direction × 3 directions).
Vibration Test : Variation of sensitivity is within 3dB after 6 hrs. of vibration test; Frenuency; 600 to 3300 rpm, Period; 1min., Amplitude; 1.5mm (2 hrs. for one direction × 3 directions).

Other useful sensors for burglar alarms and security

Sensors for other uses



MURATA's IRA sensors are available in kits, each combined with a multisurface mirror and hybrid IC pre-amplifier.

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For details of ULTRASONIC SENSOR techniques directly

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Kreuzsteinstr, 1A D-8500 Nurnberg 52, West Germany
MURATA ERIE ELECTRONIQUE S.A. (France) Phone:024-6767 Telex:699954
MURATA ERIE ELETTRONICA S.R.L. (Italy) Phone:688-4833 Telex:330385
MURATA ERIE ELECTRONICS (UK) LTD. (England) Phone:2514-28585 Telex:858971

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(Taipei Office) Phone:02-562-4218
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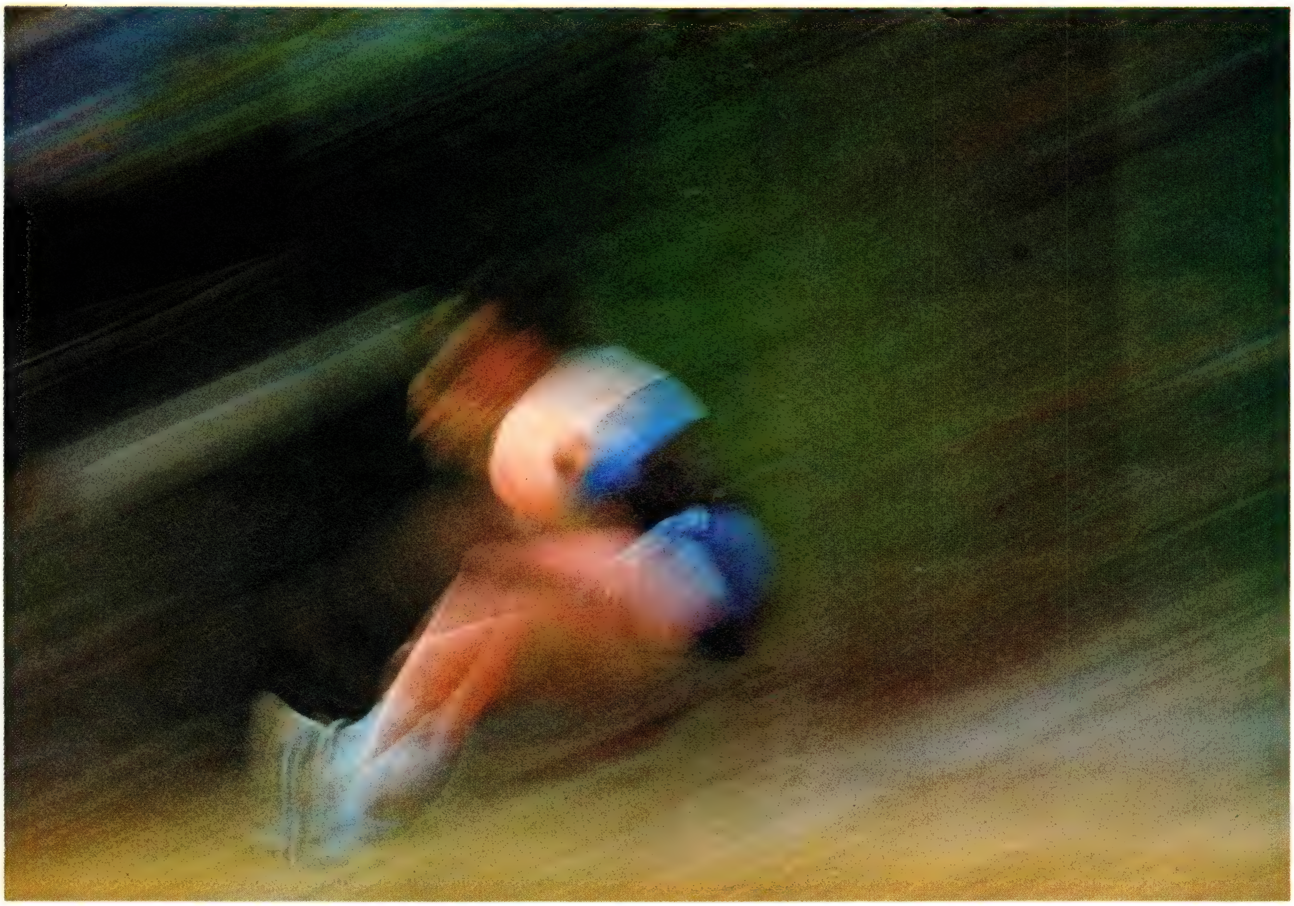

These words are not only the motto of the top olympic athletes, but they are at the same time the motto of all who strive for utmost achievement in other fields as well.
To achieve the utmost results there is only one way:
the way of sustained effort and hard work.
And that is our own way, too.
In 35 years, ISKRA has become the greatest Yugoslav electroindustrial firm with almost 100 production plants, marketing and research organizations, giving work to more than 30,000 employees, of which mostly are highly skilled specialists. Two thousand experts dealing with R + D activities pave the way for the production of sophisticated products and systems, covering especially the fields of electronics, electromechanics and electrooptics.

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- measurement and control equipment
- automation equipment
- electronic and electromechanical components
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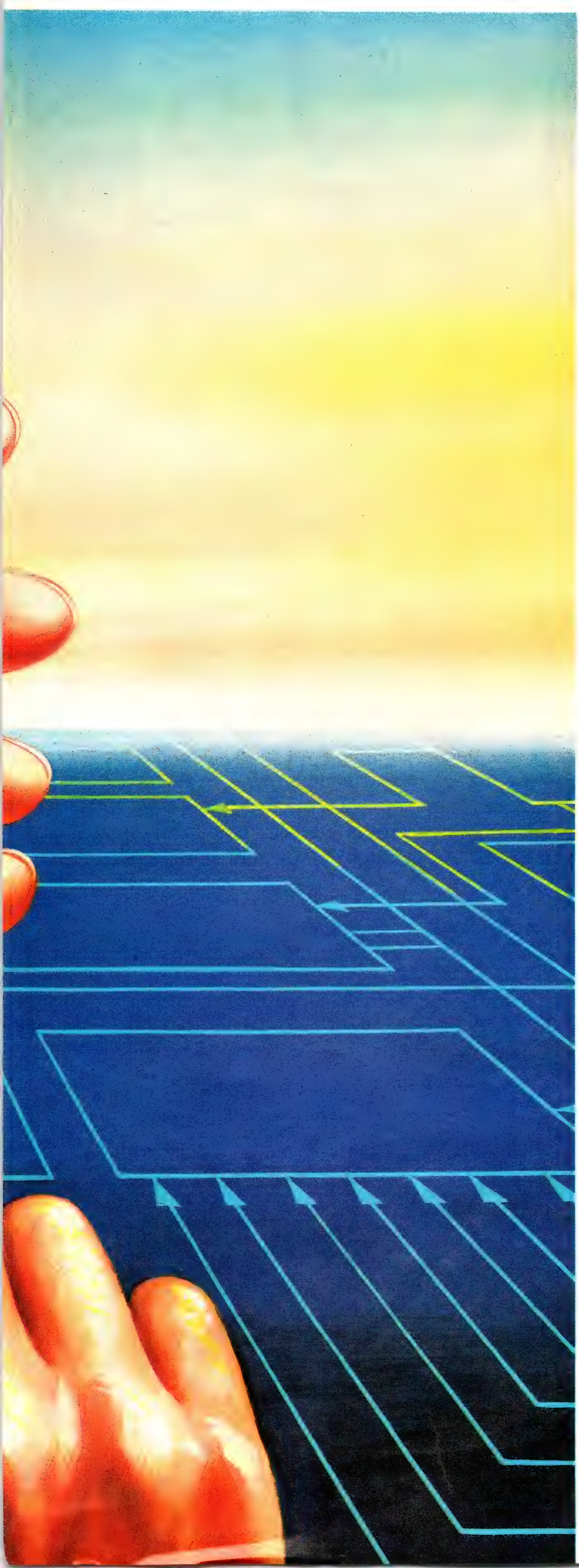

Looking for the logical way to put your logic into silicon? Just push some buttons and call MIETEC.

With an experienced **design** team and a brand new **production** plant, at one hour from Brussels, MIETEC is ready to deliver you **the chip you want for the price you were dreaming of**.

MIETEC is the only European semi-conductor house that offers you custom and semi-custom chips in a **complete range of state-of-the-art technologies**: **3 μm NMOS**, **3 μm CMOS**, **BIMOS** and **HVMOS,** a unique and trailblazing **MIETEC technology** which allows the control of high voltage switches (up to 400V) with a low voltage CMOS logic on the same chip.

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MIETEC wants to collaborate with you at any level:

Either we take care of everything. Just give us a specification and a few months later we deliver you prototypes. **Or you do the job yourself**. We give you our design rules or our cell library.
In case you want to start with semi-custom, we'll **teach you on your application**. Our designers will co-operate with you and they'll do it properly, because **MIETEC takes the responsibility of the design**.

Whatever option you make, our location in the heart of Europe (near Ghent, less than an hour from the Brussels international airport and near to Europe's major highway E3) is your guarantee for complete control of all stages of the process.

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Circle 102 on reader service card

dard packaging in TO-39 and TO-3 versions.

The line includes such features as very low on-resistance, no secondary breakdown, and high-temperature stability. Typical applications are switching power supplies, motor controls, amplifiers, inverters, choppers, and voltage regulators.

In quantities of 1,000, the isolated versions sell for $12.85 each and up, the standard TO-39 and TO-3 types from $2.31 each. The power MOS FETs are available within eight weeks after receipt of order.

Solitron Devices Inc., Semiconductor Division, 1177 Blue Heron Blvd., Riviera Beach, Fla. 33404.
Phone (305) 848-4311 [Circle 360]

Plotting software allows variable height, width of axes

Intended for use with the IBM Corp. Personal Computer, a software package called Scientific Plotter-PC produces graphs containing scientific, engineering, and business data. The software, with variable height and width of its axes, permits a multitude of grid sizes, including semi-log or log scales, the firm says. It will produce line plots, bar graphs, pie charts, or stock charts.

Data may be entered from a disk or from the keyboard, or it may be calculated by a user-defined subroutine. The data values can either be X, Y pairs, or Y values at a constant X interval. Data can be either entered in natural units with optional data scaling or offset before plotting. With 20 plotting symbols in four size ranges, multiple data sets can be compared on the same graph. Variable-length error bars may be superimposed on the symbols to indicate each point's error range.

Numeric labels are printed automatically on the axes at user-selected intervals. Text labels may be positioned anywhere on the graph by moving a cursor to the desired spot and typing the label. Four colors can be selected individually for symbols, lines, and tables.

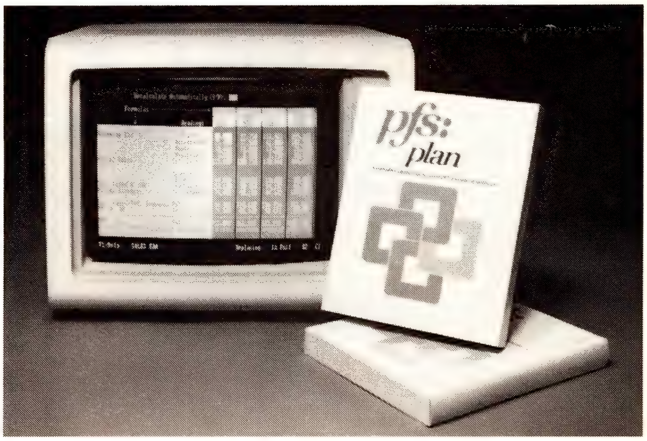
Requiring an IBM PC with 128-K bytes of memory, graphics board, disk drive, and PC-DOS 1.1, 2.0, or 2.1, the Scientific Plotter-PC is available now for $95.

Interactive Microware Inc., P.O. Box 139, State College, Pa. 16804. Phone (814) 238-8294 [Circle 363]

Beginner's spreadsheet has ease-of-use features

A spreadsheet for first-time computer users who want to develop budgets, balance sheets, income statements, and financial models is easy to use because all typing is done inside the spreadsheet itself, not in the command line. Also, the column sizes automatically adjust to accommodate the data that is entered, ensuring that the numbers appear exactly where entered.

With the PFS:Plan, column and row headings are always displayed, so the user doesn't have to scroll to the top of the page to see his location on the spreadsheet. Formulas are displayed in English next to rows or above column headings. The user can select any set of rows and columns and view them individually. Numbers from several spreadsheets can also be consolidated into one. In addition to being able to work with others in the PFS line, PFS:Plan can use files written with Lotus 1-2-3, Multiplan, and VisiCalc.



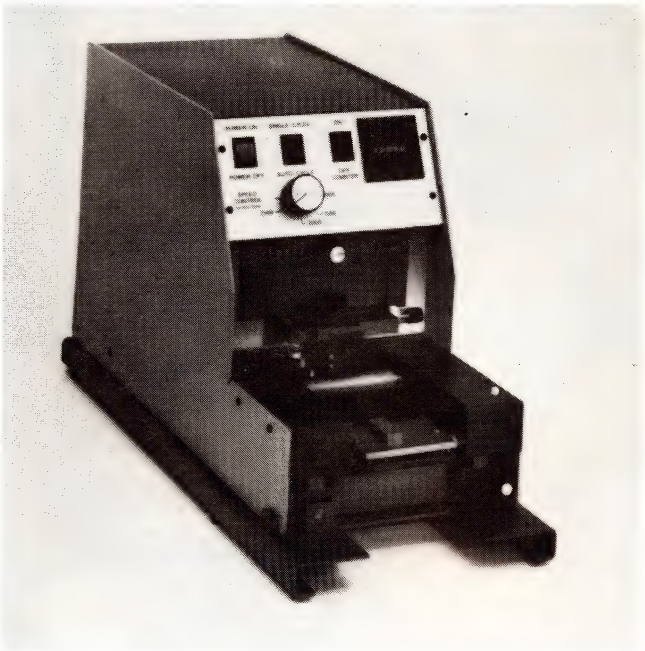
Available now for MS-DOS-based systems, the package sells for $140.

Software Publishing Corp., 1901 Landings Dr., Mountain View, Calif. 94043. Phone (415) 962-8910 [Circle 364]

Marker for DIP components does 2,600 parts an hour

An electronic component marker, the model ST2600, is designed to accommodate 0.300-, 0.400-, and 0.600-in. dual-in-line-packaged parts. The model ST2600 transfers components automatically by a tube-to-tube process and can maintain a throughput of 2,600 parts/hr or more.

Weighing 20 lb and configured for desktop operation, the electric automatic marker features simple operation, variable speed control, a built-in counter, optional single-cycle mode of operation for difficult parts, and a repeat-



Fujitsu's Micro 16sx.™ For business professionals in search of excellence.

Fujitsu's new Micro 16sx personal business computer is truly world class. A superb synthesis of speed, power, precision, quality and reliability from Japan's largest computer company.

A high clock rate makes it nearly twice as fast as other popular 16-bit micros. It also has a great memory. With 384,000 characters of RAM expandable to over one million.

More power to you. The Micro 16sx has a built-in 10 or 20 million character hard disk drive. A storehouse of information that can hold up to 6,600 or 13,200 pages of text. Other features include a real time clock with battery backup, serial and parallel ports, and a 360K 5¼″ floppy disk drive.

For business graphics, it has a high resolution tilt/swivel color monitor supported by its own RAM and microprocessor. A flexible architecture with an interchangeable 8086 16-bit microprocessor gives you built-in protection against obsolescence. With three expansion slots for future additions like mainframe or minicomputer communications. For software freedom of choice, there is no better choice. The Micro 16sx has the versatility to run MS™-DOS, CP/M-86® or multitasking Concurrent CP/M-86™ software. Take your pick.

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able printing precision to within 0.0005 in. Using standard offset ink and type, a type holder enables an operator to set up an identifying number quickly, and an optional 10-character wheel will permit number changes in less than 20 seconds. The model ST2600 is suited for high-volume operations requiring frequent type changes, such as marking programmed devices, tested components, and in-house identifying numbers.

Pricing for the marker, which will be available in approximately four weeks, ranges from $4,800 for the basic system to about $6,800 for a version that includes all options.

Sci Tech, 15011D Parkway Loop, Tustin, Calif. 92680.
Phone (714) 731-4026 [Circle 366]

Rotary transfer mechanisms handle 600 lb/in. smoothly

Based on a concept in parts-transfer technology, a series of rotary transfer mechanisms has a simplified design that has cut the initial cost and maintenance requirements and provides smooth, shockless operation, the manufacturer says.

The mechanisms are suited for handling flat parts, and they accept various tooling arms, jaws, and fingers. An extension rod for attaching magnetic or vacuum pick-ups is supplied with the basic unit. Featuring a fixed-path motion that will not require readjustment, the series has an input shaft that must be rotated. A 90° rotation of the shaft produces one complete cyclic motion of the part being handled.

Turning the shaft continuously through 360° produces four cyclic motions/revolution, taking the workpiece to successive positions in a given radius. Cycling the shaft alternately clockwise and counterclockwise causes the tooling arm to advance and return along the same path.

The prime mover for the mechanism can be a pneumatic cylinder acting through a rocker arm or a rotary actuator. However, driving the mechanism by linking it to a piece of mobile machinery eliminates all logic and sensing requirements.

Pricing for the units, which have a load capacity of 48 to 600 lb/in., range from $1,550 to $3,696. Deliveries take 30 days.

Everett/Charles Marketing Services Inc., 6101 Cherry Ave., Fontana, Calif. 92335. Phone (800) 443-1860
(in Calif. [800] 821-0589) [Circle 367]

140-megabyte drive has 30-ms average access time

Two disk drives in the Ultrastore line, a 70- and a 140-megabyte model, feature average access times of 30 ms and are intended for use where large data bases or shared resource network applications are required. Up to four drives may be used per controller, with a total capacity of 480 megabytes formatted.

The company recommends that customers use tape backup for critical files or a redundant 22- or 34-megabyte drive as a spare. It supplies 5- and 10-megabyte removable-cartridge Winchester drives as an option. The Ultrastore drives work with all computers compatible with the IBM Corp. Personal Computer.

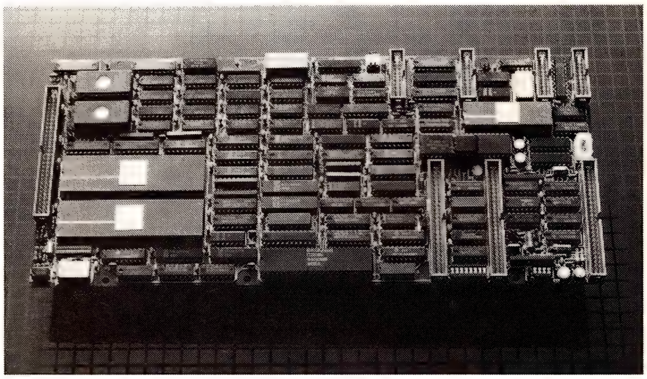
Also available is a line of hard disk drives for the Sanyo MBC 550 series, including four models of an internally installable system. The drives include a 5.3-megabyte removable drive and fixed drives with 10.6, 22.2, and 33.3 megabytes of formatted capacity. All systems include an independent power supply and controller card that interfaces to a 62-pin expansion connector.

Another line, the Diskitjr series of hard disk drives, is suited for the IBM PCjr and comes with 10.6-, 22,2-, and 34.3-megabytes fixed capacity or 5.3 megabytes removable capacity.

Prices for the 70- and 140-megabyte Ultrastore drives, available now, are $4,995 and $6,795, respectively. The hard disk drives for the Sanyo MBC 550 start at $1,695, and the Diskitjr starts at $1,495.

Systems Peripherals Consultants, 9747 Business Park Ave., San Diego, Calif. 92131. Phone (619) 693-8611 [Circle 368]

Disk controller's cache can be up to 16 megabytes



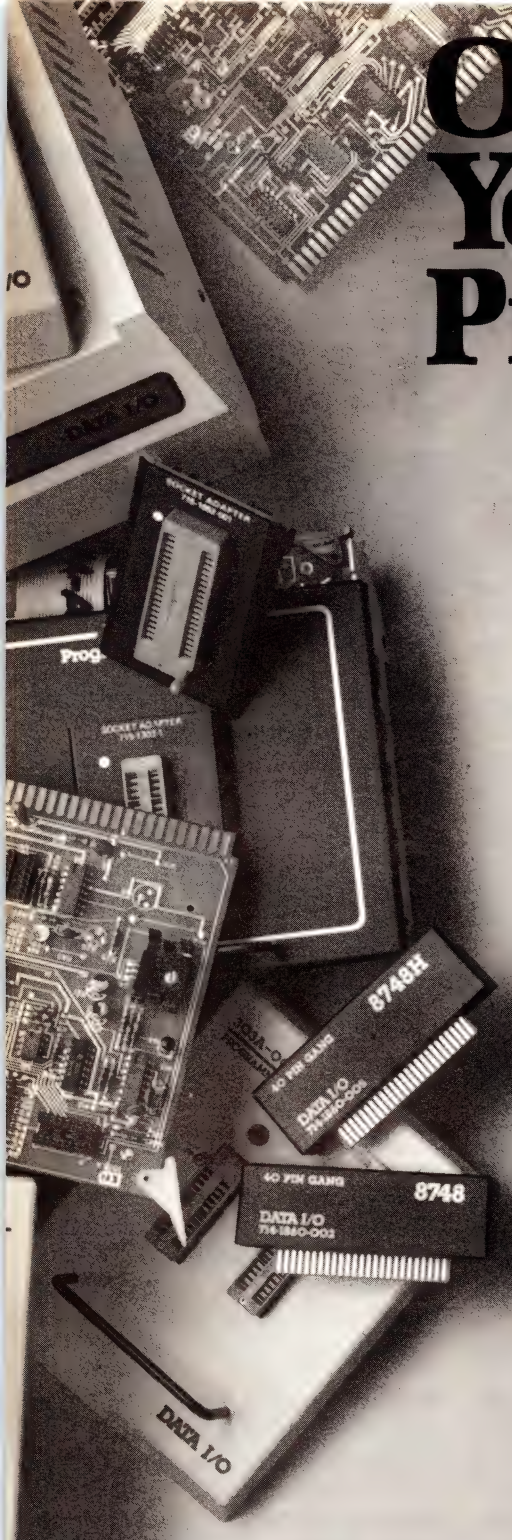
A line of caching disk controllers, the PM-3010 series, is based on a single board with an integral 128-K-byte cache random-access memory. The cache can be expanded to up to 16 megabytes with optional expansion boards, a feature that also permits designers to develop controllers for specific applications.

The PM-3010 series uses a true sector-caching algorithm instead of the track cache. Up to 128,000 sectors can be stored individually in a cache with an access time of under 400 μs. A one-page one-sector architecture results in efficient cache use. Up to four ST506, SA1000, or Winchester storage module drives plus four floppy drives can be controlled by a single 5¼-in. extended form-factor board. All PM-3010 series controllers use the Small Computer System Interface to host computers, with an average data rate of 1 megabyte/s.

In original-equipment manufacturer quantities, the series sells for $740 each. Evaluation units will be shipped during the fourth quarter, production quantities in early 1985.

Distributed Processing Technology, 132 Candace Dr., Maitland, Fla. 32751. Phone (305) 830-5522 [Circle 369]

Overcome All Your Personality Problems.



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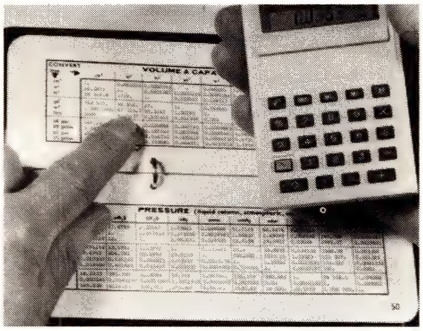
New Literature

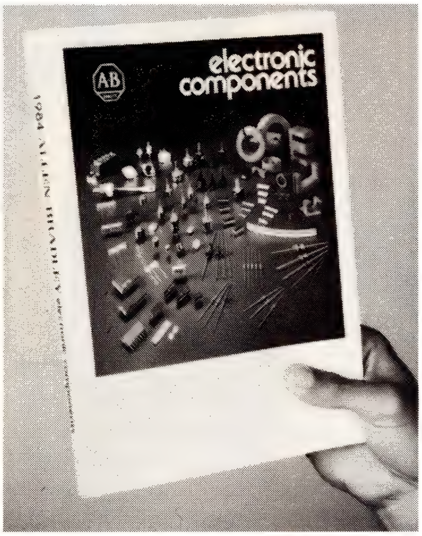
Batteries assembled. Engineered Assemblies has released the "Engineering and Design Guide," which simplifies the procedure for specifying a battery assembly for pricing and production. The guide describes and illustrates assembly styles, types of batteries, and termination capabilities. It also itemizes electrical and physical requirements as well as the nature of application and special labels or markings. For a copy, write to Engineered Assemblies Inc., P.O. Box 360, Clifton, N.J. 07011, or call (201) 340-0600. [Circle reader service number 421]

Metric demystified. A metric-conversion unit called the "Factorpak" is a looseleaf pocket book with 71 pages of conversion factors, designed for use with electronic calculators. The publisher says it includes most of the accepted units for commerce, engineering, technology, and industry—over 3,000 factors in all. The single-copy price is $9.95, and the model number is F.47. Order from Hunter Calculators, 792 Partridge Dr., Bridgewater, N.J. 08807. Phone (201) 526-8440. [Circle 422]



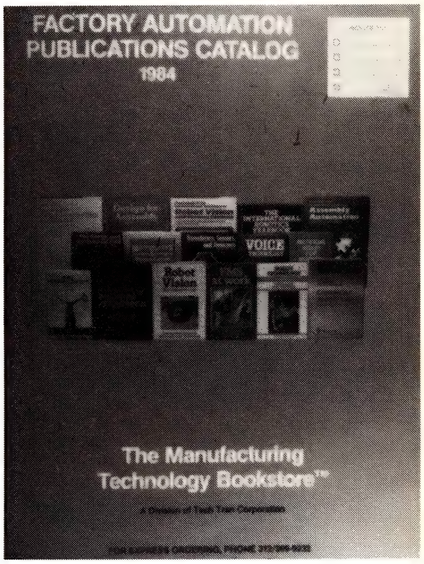
Ions at work. Engineers and equipment operators who work with ion-beam milling and ion-beam deposition have an opportunity to discover how electron-bombardment ion sources behave and how they can be used in industry. *Fundamentals of Ion Source Operation,* by Harold R. Kaufman, is a 93-page presentation of the subject by its developer. Among the topics discussed are operating procedures, ion optics, neutralization, discharge chambers, charge exchange, process implications, and maintenance and troubleshooting. A single copy is $18 plus $1 for shipping, and orders should be placed with Commonwealth Scientific Corp., 500 Pendleton St., Alexandria, Va. 22314. Phone (703) 548-0800. [Circle 425]

Components clarified. A free, 303-page catalog contains photos, charts, graphs, and application notes on surface-mounted chips, networks, semiconductors, and ferrite magnetic materials. The catalog covers such applications as automotive, computer, communications, and instrumentation. Request a copy from Allen-Bradley Electronics Group at (414) 259-2103, or write to them at 1201 S. Second St., Milwaukee, Wis. 53204. [Circle 424]



Software source. The *International Engineering Software Directory* provides a detailed technical description of each engineering software package, organized by application. Each listing in the directory is standardized and includes answers to important questions such as required hardware and software environment, minimum memory requirement, list price, documentation provided, warranty policy, technical support provided, and others. The complete vendor name, address, and phone number is also included. The directory is $35, with bimonthly new product updates available for an additional $25. For further information, write to Technical DataBase Corp., P.O. Box 720, Conroe, Texas 77305, or call (409) 539-9688. [Circle 427]

Robots revealed. The "Factory Automation Publications Catalog" features approximately 100 titles on such subjects as industrial robots, flexible manufacturing systems, sensors, control systems, automated material handling, and artificial intelligence, among others. The publications include books, special reports, conference proceedings, and periodicals. The distributor of the catalog says that they will also order publications not listed. An order form is included, and orders by phone are also accepted. To request the catalog, write to the Manufacturing Technology Bookstore, 134 N. Washington St., Naperville, Ill. 60540, or call (312) 369-9232 [Circle 426]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Defects detected. An application note, "Photothermal Imaging of Subsurface Structure," describes the use of the programmable model 5301 lock-in amplifier to characterize subsurface defects such as voids, cracks, material inhomogeneities, and failure of a thin film to bond to its substrate. This nondestructive inspection technique records laser-beam deflections propagating near the surface under analysis. A three-dimensional image of the material is also produced. Researchers will find the bibliography useful. Copies are available for the asking from EG&G Princeton Applied Research, P.O. Box 2565, Princeton, N.J. 08540. Phone (609) 452-2111. [Circle 423]

Meetings

ABA Video Banking Symposium, American Bankers Association (Sheldon D. Golub, ABA, 1120 Connecticut Ave. N.W., Washington, D.C. 20036), Hyatt Regency Hotel, Dallas, Nov. 14-16.

Comdex/Fall, The Interface Group (300 First Ave., Needham, Mass. 02194), Las Vegas Convention Center, Las Vegas, Nov. 14-18.

Videotex '84, Online Conferences Ltd. (Online Conferences Ltd., Pinner Green House, Ash Hill Drive, Pinner HA5 2AE, Middlesex, UK), The Rai Center, Amsterdam, Nov. 20-22.

China International Microelectronics/Computer Exhibition and Conference, Trade Fair Management Corp. (Harry C. Lepinske, American Exhibition Services International Inc., P.O. Box 66373, O'Hare International Airport, Chicago, Ill. 60666), Shanghai, Nov. 21-26.

Computer China '84—International Computer Technology Exhibition and Conference, Fujian Consultancy Center for Science and Technology *et al.*; **Academic Conference,** China Microcomputer Applications Association (Adsale Exhibition Services, 21/F, Tung Wai Commercial Building, 109-111 Gloucester Rd., Wanchai, Hong Kong), Xiaman Special Economic Zone, People's Republic of China, Nov. 25-Dec. 1.

Materials Research Society Fall Meeting, MRS (9800 McKnight Rd., Suite 327, Pittsburgh, Pa. 15237), Boston Marriott Hotel, Copley Place, Boston, Nov. 26-30.

Stress Analysis by Thermoelastic Techniques, Sira Ltd., British Society for Strain Measurement, and the National Engineering Laboratory (Conference Unit, Sira Ltd., South Hill, Chislehurst, Kent BR7 5EH, UK), Meeting Rooms of the Zoological Society of London, Regent's Park, London NW1, Nov. 27-28.

Power Sources Conference, PSC (Anne Weber, PSC, 3970 Atlantic Ave., Suite 204, Long Beach, Calif. 90807), Sheraton-Boston Hotel and Hynes Auditorium, Boston, Nov. 27-29.

Electronic Displays '84, Network Events Ltd. (Printers Mews, Market Hill, Buckingham MK18 1JX, UK), Kensington Exhibition Centre, London, UK, Nov. 27-29.

16th Precise Time and Time Interval Applications and Planning Meeting, U.S. Naval Observatory, *et al.* (Sheila C. Faulkner, Time Service Division, U.S. Naval Observatory, Washington, D.C. 20390), NASA Goddard Space Flight Center, Greenbelt, Md., Nov. 27-29.

30th Conference on Magnetism and Magnetic Materials, IEEE *et al.* (Conference Steering Committee, c/o Richard M. Josephs, Code 5023, Naval Air Development Center, Warminster, Pa. 18974), Town and Country Hotel, San Diego, Nov. 27-30.

Robots West Conference and Exposition, Robotic Industries Association and Society of Manufacturing Engineers (Public Relations Deparment, SME, P.O. Box 930, Dearborn, Mich. 48121), Anaheim Convention Center and Hilton Hotel, Anaheim, Calif., Nov. 27-30.

1984 National Data Systems Forum and Exhibit, Transportation Data Coordinating Committee (1101 17th St. N.W., Washington, D.C. 20036), Baltimore Convention Center, Baltimore, Nov. 28-29.

Seminars

Advances in Thin Film Technology: Sputtering and Etching (Rosemary McPhillips, Materials Research Corp., Orangeburg, N.Y. 10962) Santa Barbara Biltmore Resort, Santa Barbara, Calif., Nov. 13-15.

The Relational Database (The American Institute for Professional Education, Carnegie Building, 100 Kings Rd., Madison, N.J. 07940), The Netherland Plaza Hotel, 5th and Race streets, Cincinnati, Nov. 19-20

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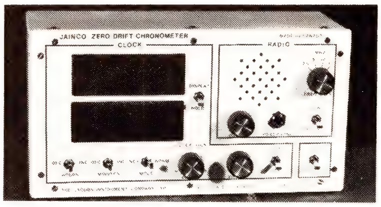

The JAINCO Zero-Drift CHRONOMETER

The JAINCO Chronometer consists of a Four-Channel crystal-controlled radio for receiving all the major carriers of WWV/WWVH. By a unique system of circuits, two displays of GMT (LED for nights, LCD for days) are presented and are continuously updated to give the correct second. A crystal-controlled clock gives seconds also, for use in updating the displays when the radio tick is missing (29th and 59th sec of each minute), and on the rare occasions when you can't receive WWV and/or WWVH. This gives a time "tick" based on the legendary accuracy of WWV (1 part in 100 billion!). Also includes a "freeze-frame" switch for celestial nagivators. Has an earphone jack.

The radio-synchronized chronometer was conceived by our President, Don Jacobs N (an IEEE Fellow), in 1977. For a free copy of his pioneering (unpublished) 1977 paper, send a No. 10 SASE to us. If you can't get Canadian postal stamps, send $1.00.

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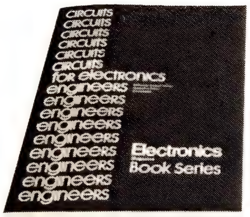

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Letters

We should meet the Russians

To the editor: I am certain that even without a formal relationship between the IEEE and the Popov Society ["The IEEE would do well to reject Soviet deals," *ElectronicsWeek*, July 30, 1984, p. 72], there is no disruption of the distribution of IEEE printed technical material within the USSR.

I am also certain that their representatives attend all unclassified conferences and shows of the IEEE both in the U.S. as well as in other parts of the world. Therefore, in my opinion, no additional technical information will be furnished to the USSR by formalizing the relationship between both engineering societies.

However, personal contacts are important. This permits us to evaluate the quality of their specialists. It also opens a window to the West for the Russian engineers, who are usually in high policy-making positions. We also have learned by experience that our breaking off of scientific and technical relations has had no impact on Afghanistan or the treatment of Soviet dissidents.

I also disagree strongly with the statement that "The Soviet Union has a great deal to gain and absolutely nothing to lose. . . ." Technical Russian progress is excellent in some fields, e.g., titanium submarines that outrun our torpedoes.

Bruno O. Weinschel
Gaithersburg, Md.

Cut trade with Japan

To the editor: I was delighted to see your editorial regarding trade with Japan ["Now is the time to halt dumping," *ElectronicsWeek*, August 13, 1984, p. 84]. I have been writing to government people for a few years now, trying to convince them that Japan has no intention of opening up for free trade. It has been to no avail, since our government has never had to meet a payroll while trying to compete in a one-sided trade war.

There is no free trade with Japan. Industries are targeted and picked off one by one. Meanwhile, our imports to Japan are restricted by both tariff and nontariff barriers.

This is not sour grapes. I work for a major multinational and we have been relatively unhurt, mainly because we have enough innovative new products to hang in there against Japan. Even so, import duties into Japan are higher than for their equipment coming here. (A Ford Motor Co. manager once told me how the Japanese government's foregoing of that country's value-added tax on their export cars gives them a 7% or 8% advantage.) We just want basic fairness—no targeting, and no nontariff barriers.

By the way, I enjoy your new format.

John Minck
Palo Alto, Calif.

Was there first

To the editor: The claim put forward that current control was a new technique in switching power supply design [*Electronics*, March 24, 1983, p. 48] is unfounded. As witnessed by U.S. patent number 3,742,371, issued on June 26, 1973 to Frank Churchill and me—inventors of this method at Tektronix in 1969—this control technique is 15 years old and well proven in the field. The last time I used it was in May 1983, when I initiated the design of an off-line VMOS SMPS for a video recorder.

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Editorial

RAISING TARIFF BARRIERS MEANS NEW PROBLEMS

Looming large this year as an election issue is the matter of protective tariffs. The steel and auto people in particular, seizing an opportunity that presents itself only once every four years, are demanding that the President raise tariff barriers to protect jobs and, indeed, their very industries.

Now two electronics trade associations have added their voices to the clamor. The Electronic Industries Association and the American Electronics Association are putting their muscle behind a congressional bill that would increase by 35% the tariffs on telecommunications equipment coming into the U.S. unless foreign suppliers of that equipment open their markets to U.S. suppliers [*ElectronicsWeek,* Sept. 24, 1984, p. 36]. The measure's obvious target: the Japanese.

The bill, the EIA, the AEA, and high-tariff backers in general are all wrong. For one thing, the immediate result of higher tariffs or any similar anticompetitive action is higher prices. Thus U.S. taxpayers would wind up paying most of what it costs to protect the native telecommunications industry. For another, if the U.S. increases the height of its telecommunications wall, then Japan would surely retaliate with yet another layer of bricks for its barricades against whatever U.S. goods it imports—computers, for example.

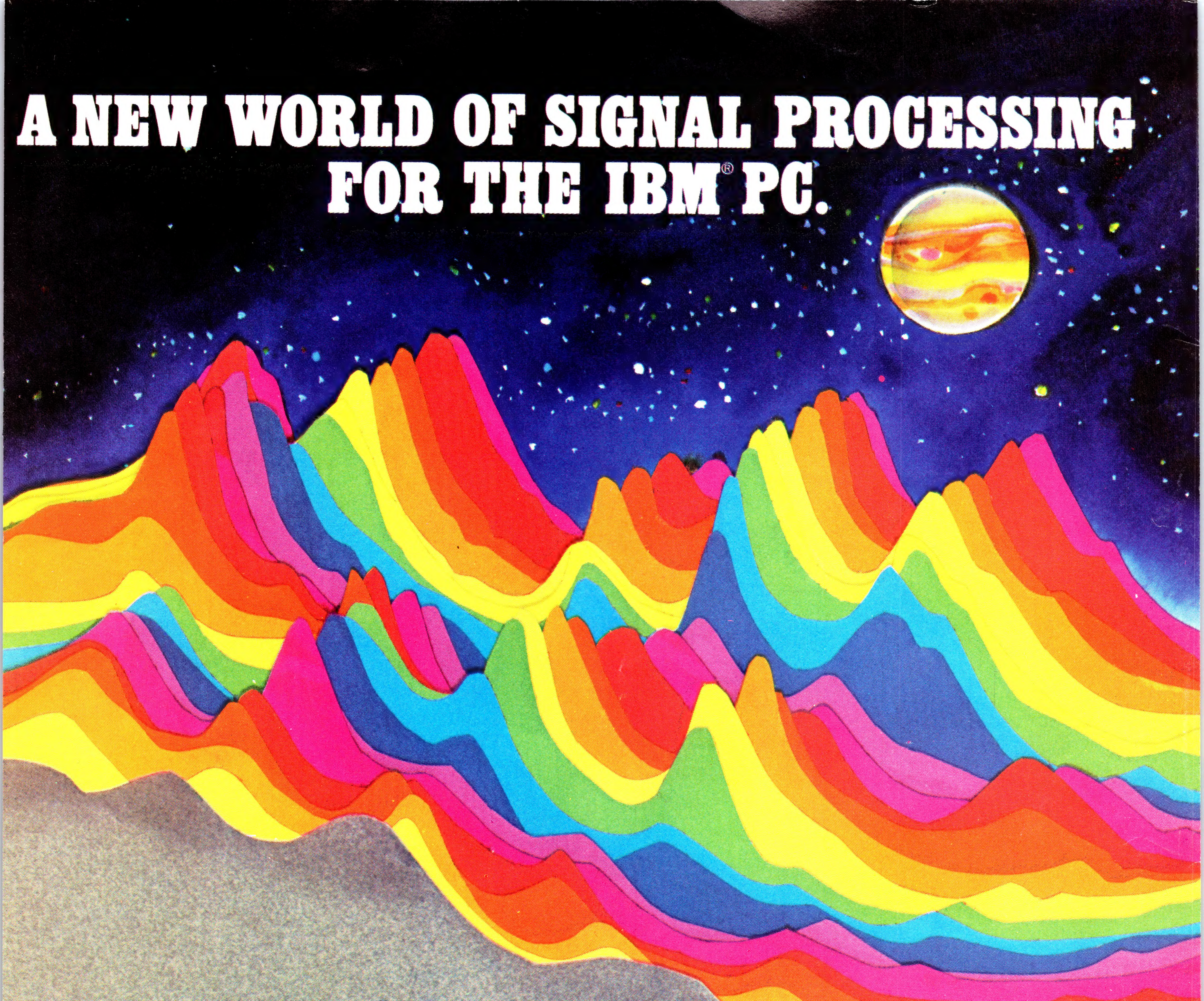
The result, as one popular scenario pictures it, is that with the U.S. gusher reduced to a trickle, the Japanese would be forced to accelerate their computer-development efforts. Thus, any benefits accruing to the U.S. telecommunications industry would eventually be more than balanced by benefits to the Japanese computer industry. And the opportunity to retaliate is not limited to Japan: as a U.S. government official points out, there could be a problem in Europe with the European Community choosing to join the fray by restricting sales activities of IBM Corp.

Incidentally, it would be easier to take U.S. industrialists' complaints more seriously if they hadn't been so eager for quick profits when they were selling their technology to foreign competitors—especially the Japanese.

As far as sales of telecommunications equipment are concerned, no doubt Japan is playing its well-known predatory game of "I can sell to you, but you can't sell to me." Although Nippon Telegraph & Telephone Public Corp. has nominally opened its purchasing to all comers, executive suites in the U.S. are rife with horror stories about what companies have had to go through to sell dribs and drabs of equipment to NTT.

Still, some progress is being made. The Japanese government should be induced, not through tariff penalties but through negotiation, to speed the process. For example, the U.S. could threaten to reduce its military presence in the islands—that would have considerable effect on the Japanese economy as well as on the Japanese psyche.

Quite simply, the market should be free and open to technological competition, and may the best technology win. It was that set of conditions that enabled the U.S. industry to gain its upper hand in the telecommunications business in the first place, and that's the way it must regain that edge. Any tariff help from the government would be short-term only, and in the long term would cost more than it would be worth. Hysteria is a waste of energy and is no substitute for innovation. Rather than waste their resources lobbying for potentially destructive government aid, the companies involved should be devoting all their resources to winning back the territory.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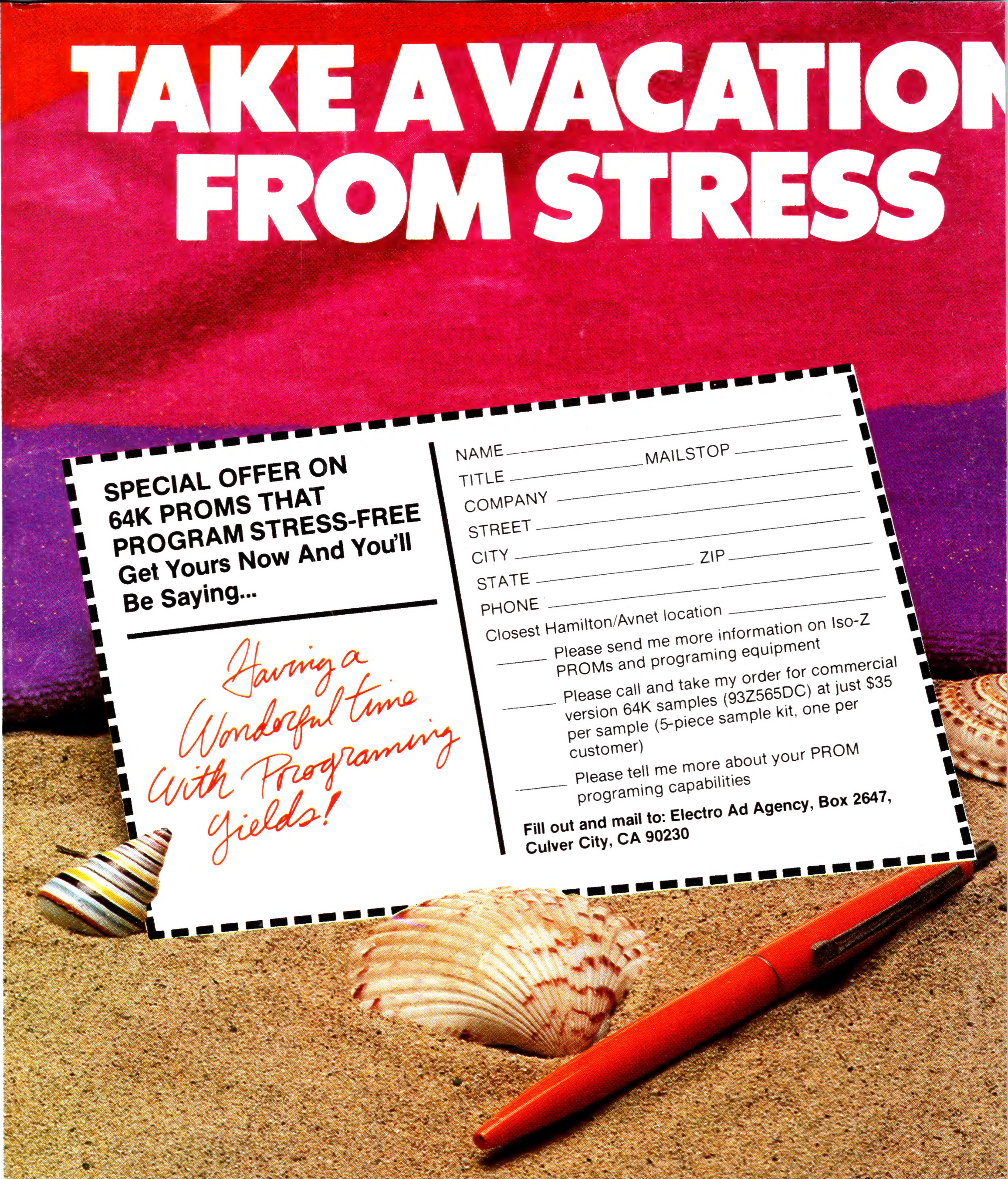

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